Generative mechanisms of IT-enabled organisational performance in resource-constrained Emergency Medical Services organisations in South Africa

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A thesis submitted in fulfilment for the
degree of Doctor of Philosophy in Information Systems

in the
Faculty of Commerce
Department of Information Systems

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October 2018

Declaration of Authorship

I declare that **"Generative mechanisms of IT-enabled organisational performance in resource constrained EMS organizations in South Africa"** is my own work, that it has not been submitted for any degree or examination in any other university and that all the sources I used or quoted have been indicated and acknowledged by appropriate references.

YASSER BUCHANA
Signed:

Signed by candidate

Date: 09 October 2018

“ Knowledge exists in a human soul like the seed in the soil; by learning, the potential becomes the actual.”

— Abu Hamid Al-Ghazzali

Abstract

Problem Statement: Emergency medical services (EMS) organisations have one of the highest levels of dependence on and use of information technology (IT) to support delivery of emergency medical services. The need for EMS organisations to provide efficient and effective emergency medical services has emphasised the importance of performance management. Organisational performance which is monitored and evaluated through key performance indicators (KPIs) plays an important role in EMS organisations. Organisational performance helps to monitor, evaluate and communicate outcomes in the form of KPIs. Empirical evidence shows that quantitative KPIs have been designed with little in-depth understanding of the underlying IT usage mechanisms that influence organisational performance. Unfortunately, such quantitative KPI reports have been limited in explaining organisational performance underpinned by IT.

Purpose / rationale of the research: The purpose of this research study was to identify the generative mechanisms associated with IT-enabled organisational performance and to explain how these mechanisms interact. In the context of resource-constrained EMS organisations, quantitatively defined KPIs are not suitable for explaining the underlying causes of performance variations and outcomes. The lack of empirical evidence on IT-enabled organisational performance as well as the lack of theoretical explanations of the underlying mechanisms provided the primary rationale for this study. In addition, this study sought to provide answers to the following research question: What generative mechanisms explain IT-enabled organisational performance in resource-constrained EMS organisations?

Theoretical approach/methodology/design: This study was informed by the critical realist philosophy of science and used the complex adaptive systems theory together with institutional theory as the theoretical lenses to investigate the research question in a manner that jointly explained the generative mechanisms. Using interviews, participant observation, organisational performance data and documents collected from a single case study, the study used abduction and retroduction techniques to explicate the mechanisms of IT-enabled organisational performance.

Findings: Findings indicate that the IT-enabled organisational performance mechanisms can be categorised into two types of generative mechanisms. These are

structural and coordination mechanisms. The explanation of the mechanisms developed in this study take into consideration three important elements: (1) the technological, cultural and structural mechanisms that influence IT-enabled organisational performance; (2) the unpredictable, non-linear, adaptive nature of emergency medical services environments; and (3) the complexities that arise in the interactions between EMS organisations and their environments.

Originality/contribution: In respect of IT-enabled organisational performance this study contributes to both organisational and health information systems literature by developing a multi-level research framework that is informed by the realist philosophical stance. The framework plays an explanatory role which relates to its inherent ability to offer explanatory insights into the necessary mechanisms that give rise to organisational performance. This framework has the potential to guide empirical research and provide theoretical explanations of different domains or disciplines that are concerned with identifying IT usage mechanisms which influence organisational performance. These include the significance of the coordination and structural mechanisms which, under differing conditions of uncertainty, produce variations in performance outcomes.

Implications: Findings from this study can be integrated into broader emergency medical policy planning and health programme management. The model developed by the study provides a fresh understanding of the underpinning mechanisms enabling performance in resource-constrained EMS organisations. It can be used to assist emergency medical institutions and practitioners in South Africa and other sub-Saharan African countries, especially Southern African Development Community (SADC) countries to improve emergency medical service delivery to the public. The findings provide a guide for improving management of emergency medical situations and resources in their respective resource-constrained contexts. Furthermore, findings from the study can also guide imrpoved design and implementation strategies and policies of EMS systems initiatives in South Africa and sub-Saharan developing countries.

Acknowledgements

First and foremost, I would like to express my gratitude to the most merciful, Almighty Allah for all the blessings in my life. Secondly, I would like to express my sincere appreciation to the following people for their invaluable contributions towards the completion of my PhD thesis:

1. My family, for all the sacrifices they have made for me to be where I am today. My mother Sada Mukamunana in particular. My brother Faycal Buchana and my sister Habiba Buchana, thank you from the bottom of my heart for all the patience you've had from the first day when I began this journey.

2. My friends. It would be very difficult for me to name all of you, but I am very appreciative of all the inputs and encouragements.

3. My supervisor Professor Lisa Seymour for all the support and guidance.

4. Prof Ojelanki Ngewnyama for opening me up to new frontiers of research in Information Systems.

5. The PhD course convenor Prof Irwin Brown and all the admin and support staff in the information systems department.

6. My PhD colleagues: Samwel Mwapele, Dr Kaski Bisimwa, Dr Chidi Ononiwu, Mohammed Al'Hassan, Dr Frank Makoza, Irene Kesewa, Paul Mungai, Laban Bagui, Gordon Nana Kwesi Amoako, Tapfuma Pashapa, Gwamaka Mwalemba, Musa Chemisto, Carrington Mukwasi, Pitso Tsibolane, Ricardo Harry, Zainab Ruhwanya and last but not least, special thanks to Malcom Garbutt.

List of publications

Peer Reviewed Journal Article

Buchana, Y., Garbutt, M., & Seymour, L. F. (2018). Identifying Micro-Level Generative Mechanisms of ICT-Enabled Performance Improvement in Resource-Constrained Healthcare Organisations: A Critical Realist Perspective. *The Electronic Journal of Information Systems in Developing Countries*, e12057.

Peer Reviewed Conference proceedings

Buchana, Y. and Seymour, L. (2017, August). Institutional Logics of IT- enabled Organizational Performance in Resource Constrained EMS Organizations. In: *Twenty-third Americas Conference on Information Systems*. [online] Boston, USA.

Buchana, Y., & Seymour, L. (2015, September). Theorising inter- organisational health information systems as complex adaptive systems in the context of emergency medical services. *InProceedings of the 2015 Annual Research Conference on South African Institute of Computer Scientists and Information Technologists* (p. 7). ACM.

Buchana, Y., & Seymour, L. Factors influencing successful implementations of health information systems in public healthcare organisations in sub-Saharan countries. *InProceedings of the 2015 African Conference on Information Systems*. [online] Accra, Ghana.

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Abbreviations

CAD	**C**omputer **A**ided **D**ispatch
CR	**C**ritical **R**ealism **S**ervices
CAS	**C**omplex **A**daptive **S**ystems
EMS	**E**mergency **M**edical **S**ervices
IT	**I**nformation **T**echnology
KPA	**K**ey **P**rocess **A**reas
KPI	**K**ey **P**erformance **I**ndicators
SPMS	**S**taff **P**erformance **M**anagement **S**ystem

Dedications

This research study is dedicated (in loving memory) to my father Habib Bucyana. My father taught me at an early age the value of a formal education and always believed in my abilities. May the Almighty Allah grant him a high place in Janaah-tul-Firdaous (Insha'Allah).

This study is also dedicated to four very special people:
(1) Brado Nkanga, (2) Mrs Mzwaki Mshengu, (3) Mrs Amina Mankaa and (4) Mrs Wardha Mulla.
I have no words to describe how thankful I am to you.
For as long as I live, You will always have a special place in my heart.

Finally, this thesis is also dedicated to my mother Sada Mukamunana, who gave me the freedom to follow my dreams in life. My mother sacrificed a lot for me to be where I am today. To this day, she continues support and empower me with her infinite wisdom.
She is my heart in a human form.

Chapter 1

Introduction

1.1 Background

Over the years research in Information systems (IS) has drawn attention to the use of information and communication technologies (ICTs) in healthcare organisations (Bai, Meredith, & Burstein, 2018; Chaudhry et al., 2006; LeRouge, Mantzana, & Wilson, 2007). This is substantiated by the increasing popularity of empirical research focusing on countless IT issues affecting healthcare organisations (Bhattacherjee & Hikmet, 2007; Jones, Rudin, Perry, & Shekelle, 2014; Turoff, 2002). Amongst others, these include adoption and implementation of electronic health records, the use of tele-health systems, mobile health, etc. Mayer-Schonberger (2002) argues that IT in healthcare facilitates information exchange which in turn promotes co-operation and collaboration through the effective use of information technology to achieve a common goal of saving lives.

With respect to the healthcare sector, in particular Emergency Medical Services (EMS), the use of IT in public EMS organisations (e.g EMS, Law enforcement services, Fire department, etc.) has played an important role in delivering EMS to the public by providing time critical information and enabling faster response to emergency situations (Mears, Ornato, & Dawson, 2002; Scholl & Klischewski, 2007; Van de Walle, Turoff, & Hiltz, 2009). Public EMS organisations are complex entities whose primary role is to provide pre-hospital emergency services to sick and injured patients (Blackwell & Kaufman, 2002; Razzak & Kellermann,

2002). EMS organisations consist of many different components and stakeholders such as service providers, paramedics, patients, governments, etc. (MacFarlane & Benn, 2003). The various components and stakeholders are interlinked by a nexus of responsibility and accountability relationships. Accountability plays an important role in ensuring that diverse stakeholders involved in the provision of emergency services are either held to account or rewarded for their actions (Boyd, Micik, Lambrew, & Romano, 1979; Hausvik, 2017a; Moore, 1999). Effective accountability requires data that to be well organised into aggregated information (Menon, Lee, & Eldenburg, 2000).

Increasingly, public EMS organisations are under pressure from governments and other stakeholders to provide explanations of variations in performance outcomes measured against their resources (LeRouge et al., 2007). Often performance targets are not met due to unpredicted factors or numerous eventualities internal or external to the EMS organisation (Erkut, Fenske, Kabanuk, Gardiner, & Davis, 2001; Kim & Michelman, 1990)

1.2 Problem statement and research gap

It is well established in IS literature that IT has been used to help deliver EMS. As such, through the use of IT, multiple Key Performance Indicators (KPIs) have been used to assess performance outcomes in EMS organisations. These KPIs include effectiveness, efficiency, quality of care and responsiveness (measured in mission time) to emergency services (Murphy, Wakai, Walsh, Cummins, & O'sullivan, 2016; Wakai et al., 2013). To assess these outcomes, managers are often overwhelmed with large volumes of data that makes it difficult to decipher the information at hand (Cretikos et al., 2006). Hence, the use of IT to aggregate multiple performance indicators into simplified measures that are used by decision makers to assess organisational performance (Dahlgaard, Pettersen, & Dahlgaard-Park, 2011). However, organisational performance has primarily been assessed on the basis of KPIs that have been designed without in-depth understanding of the underlying IT mechanisms that influence organisational performance. Such KPI reports have been limited in explaining the outcomes of organisational performance underpinned by IT. Furthermore, there are fundamental problems associated with the use of KPI measurements models when

seeking to interpret, attribute the causes of performance variations. In the context of resource constrained EMS organisations, KPIs are not suitable for explaining the underlying causes of performance variations in organisational performance outcomes.

Anderson et al. (2006) argue that the focus on mechanisms allows the enquirer to go beyond the superficial descriptions and instead to dive deeper to uncover more subtle details about a phenomenon. For example, when two constructs X and Y are correlated, very little is known other than that the fact that there is some form of relationship between X and Y. In this case, if X is considered an IT-use construct, and Y an organisational performance construct, the relationship between IT usage and organisational performance is not well explicated (Burton-Jones & Grange, 2012), such as for example, how IT usage can enable organisational performance.

An investigation into the relationship between IT use and organisational performance in the context of resource constrained EMS organisations is essential because provision of emergency services to sick and injured patient is highly supported by, and involves an intensive use of IT (Bai et al., 2018; Hausvik, 2017b; Jones et al., 2014). In addition, it has been established that IT has a major influence on delivery of emergency services operations (Anderson et al., 2017; Athey & Stern, 2002). Organisational performance which is measured and reported in terms of KPIs holds an important status in EMS organisations. However, previous research shows that these quantitative KPIs have been designed without in-depth understanding of the underlying IT usage mechanisms that influence organisational performance. Unfortunately, such performance quantitative KPI reports are limited in explaining the outcomes of organisational performance underpinned by information technology (IT).

Questions remain about the extent and nature of the relationship between X (IT-use) and Y (organisational performance). For example, does X cause Y? or does Y cause X? Are the two constructs in fact not causally related and the relationship between X and Y simply the result of some plausible but false, or unintended correlation between the two generated by a third unobserved construct, Z? To answer these questions requires moving beyond the superficial descriptions of the relationship between X-Y and instead to address the questions of why and how the relationships emerge. Consequently, the lack of explanations of why specific antecedents are linked to specific organisational performance

outcomes, has also been emphasised in literature (Grandori & Soda, 1995; Kim, Choi, Qualls, & Park, 2004). As a result, there is a need for research with a specific focus on developing useful theoretical explanations which provide in-depth analyses of the underlying factors, mechanisms and structures, their triggers as well as consequences, in shaping organisational performance in resource constrained EMS organisations (Vincent, 2008, p. 567-8). Hence, Critical Realism (CR) is considered an appropriate philosophy of social science that can be used to address this knowledge gap.

1.3 Research Questions

Considerable lack of empirical evidence of IT-enabled organisational performance as well as the lack of theoretical explanations into the underlying mechanisms provided was a major rationale for this study. Hence, this study has attempted to shed light on how the use of IT to support EMS operations influences organisational performance in resource constrained EMS organisations. The purpose of this research study was to identify the generative mechanisms associated with IT-enabled organisational performance and to explain how these mechanism interact. To be more specific, this study sought to provide answers to the following primary research question:

RQ: What generative mechanisms explain IT-enabled organisational performance in resource constrained EMS organisations?

In this study, the view of generative mechanisms is taken from Blom and Morén (2011). They describe generative mechanisms as "... a trans-empirical but real existing entity, explaining why observable events occur". As such, in the context of this study, generative mechanisms are considered as underlying processes that explain the observed relationship between IT-usage and organisational performance (in the context of resource constrained EMS organisations). By seeking the generative mechanisms that underpin IT enabled organisational performance, the primary research question is intended to highlight two important aspects. On the one hand, it highlights the existence of a myriad of mechanisms attributed to IT (which plays both a central role to the delivery of emergency services) and, on the other the way in which delivery of emergency services depends on the complex relationships and interactions between underlying IT

(functional and dysfunctional) mechanisms that exist in resource constrained EMS organisations.

To find answers to the main research question, two sub-questions are proposed:

1. Why and how do the mechanisms produce the observed organisational performance outcomes in resource constrained EMS organisations?
2. What contextual conditions exist and how do they influence IT-enabled performance mechanisms in the attainment of organisational performance outcomes?

1.4 Research aim and objectives

The main aim of the study is to develop explanations of the mechanisms that enable EMS organisations to achieve their organisational performance outcomes through the use of IT. Anderson et al. (2006) argue that "... [a] focus on mechanisms enables one to move beyond thinking about individual variables and the specific links between them to considering the bigger picture of action in its entirety." The objectives of this research study are:

1. To determine the generative mechanisms associated with IT-enabled organisational performance in the context of resource-constrained EMS organisations.
2. To explain how the identified mechanisms work.
3. To identify and explain the contextual conditions in which the identified mechanisms are activated.
4. To develop a model that links objectives 1, 2 and 3 to derive a CR based explanatory model of IT-enabled organisational performance in resource constrained EMS organisations.

1.5 Rationale of the study

The need for EMS organisations to provide efficient and effective emergency medical services has emphasised the importance of performance management, which monitors, evaluates and communicates organisational performance outcomes in the form of KPIs. Research has shown that slow and inefficient emergency services have dire consequences on a country's healthcare system (Blackwell & Kaufman, 2002; Razzak & Kellermann, 2002). While performance management helps to analyse outcomes and recommend strategies as well as protocols for improving productivity, performance management itself does not identify the underlying causal mechanisms that lead to observed performance outcomes in an organisation.

Furthermore, the use of IT to support the provision of emergency services and to improve performance outcomes in resource-constrained organisations has produced diverging results. The result of that discrepancy is that performance management and outcomes help to show that things may not be working as desired or expected, yet they do not inform what caused the observed problems/issues in order to attain desired performance goals. A number of research studies have shown that gaps exist between the use of IT to improve performance in healthcare organisations and the institutional contexts that govern EMS provision (Christiaanse & Huigen, 1997; Kobusingye et al., 2005; F. Peng, Kurnia, Lederman, Dreyfus, & Knott, 2013; Spaite, Criss, Valenzuela, & Guisto, 1995).

Literature on IT and organisational performance point to various perspectives that have been used to study this phenomenon (Chatterjee & Ravichandran, 2004; T.-M. Yang & Maxwell, 2011). As such, different authors have emphasized the importance of the diverse attributes of IT and organisational performance structures. For example, Grandori and Soda (1995, p.184) argue that IT comprise "nexuses of integration mechanisms encompassing all the range of organisational coordination devices [...] in addition to [...] mechanisms". These structures are important because they have been linked with positive organisational performance, knowledge sharing, productivity advantages (Dyer & Nobeoka, 2000). Although most derived benefits of the use of IT in EMS organisations have been associated with the agency of actors, the real underlying

causes of variations in organisational performance outcomes are highly under-theorized (Allen, Karanasios, & Norman, 2014; Lyytinen & Damsgaard, 2011; Ring & Van de Ven, 1994; Sydow & Windeler, 1998).

1.6 Research philosophy

Literature has observed that organisational performance is influenced by many factors, however most of these studies have been limited to the empirical level thus limiting assessment of the phenomenon. In response this study was informed by the CR paradigm which allowed for analysing and elucidating the hidden mechanisms through the ontological stratifications of CR. The ontological stratification made it possible to theorise enabling and disabling mechanisms and the contextual factors in which these mechanisms operate (Blom & Morén, 2011).

Critical Realism (CR) was chosen as an appropriate philosophy for the research paradigm (Archer, Bhaskar, Collier, Lawson, & Norrie, 2013; Bhaskar, 2008) guiding this study. CR asserts that there are real underlying causes, structures, processes and entities that give rise to the observations humans make of the world. CR has a stratified ontology (Empirical, Actual and Real) and allows for a broad and flexible epistemic approaches.

The goal of CR-based research is to seek explanations rather than predictions (Lee & Hubona 2009). The objective is to provide clear, concise and empirically supported statements about causation, that is, why and how a phenomenon occurred (Bhaskar, 1998, 2016). Hence, in this study, a CR perspective that focuses on the inter-relationships between the causal mechanisms, social structures and performance outcomes is used to provide explanations of how organisational performance outcomes are achieved in resource-constrained EMS organisations.

1.7 Theoretical approach

With the abundance of extant theories available to explain the generative mechanisms of organisational performance in EMS organisations, IS scholars emphasize the need for theoretical approaches that encompass the aspects of structure

and agency (Drnevich & Croson, 2013; Eisenhardt, 1989a; Gregor, 2006). CR as a philosophical approach adequately incorporates the elements of structure and agency (Archer, 1995; Mingers, Mutch, & Willcocks, 2013; Sayer, 1992). The fundamental principle for theory in CR is that, real mechanisms have latent powers to produce actual events in the real world (Astbury & Leeuw, 2010; Avgerou, 2013). These events may or may not be observed in the empirical domain (Okoli, 2012).

Avgerou (2000) notes that both organisational practice and IT innovation are regarded as institutions. She argues that IT and organisational practice constitute specific but distinctive mechanisms operating at different institutionalization levels in an organisation (Avgerou, 2000). However, because the public healthcare sector is a complex industry in which institutionalizations of work practices are common institutional theory affords a theoretically resilient source for investigating the non-linear dynamics of IT mediated work practices and assimilation in EMS organisations (Currie, 2009). Furthermore, given that EMS organisations operate in time critical, dynamic and highly unpredictable environments, complexity science is a valuable and appropriate theoretical framework for investigating the IT usage structures and mechanisms that produce the emergent organisational performance outcomes.

Complex Adaptive Systems (CAS) theory is a useful theory for developing explanations of the mechanisms of organisational performance because it helps to explain how organisations behave, self-organise, and adapt under different environmental conditions. Therefore, CAS theory in conjunction with institutional theory offers an appropriate approach for theorising IT-enabled organisational performance which are influenced by technological, cultural and structural forces, as well as, external environmental dynamics, mechanisms as "emergent" (Orlikowski & Barley, 2001).

1.8 Methodological approach

The case study method was considered appropriate in this study because it provides an opportunity to focus in depth on the causal mechanisms, contextual factors as well as their various interactions, in order to elucidate better explanations for the observed outcomes (Ryan, Tähtinen, Vanharanta, & Mainela, 2012).

Various authors have proposed case study methods as the most suitable approach to conduct CR based research (Ackroyd, 2010; Easton, 2010; Mingers, 2004a; Wynn & Williams, 2012). EMS organisations have emergent properties that are a result of the various agential interactions which often involve causal mechanisms. However, these causal mechanisms and emergent properties are not directly observable, but they can be indirectly apprehended through a meticulous and iterative reconstruction guided by some explanatory frameworks (McAvoy & Butler, 2018).

In this study, the Bygstad et al. (2016) was used to guide the methodology for exacting the mechanisms, with CAS theory and institutional theory providing the necessary theory for investigating the factors, causal structures as well as the various relationships between different entities, actors and groups.

1.9 Practical implications

Findings from this study could be integrated into broader emergency medical policy planning and health programmes management. The model developed by the study could assist emergency medical institutions (and practitioners) in South Africa and other sub-Saharan African countries, especially Southern African Development Community (SADC) countries, with a fresh and better understanding of the underpinning mechanisms enabling performance in resource constrained EMS organisations. Knowledge about these mechanisms could help improve emergency medical service delivery to the public especially in poor and under-served communities. In addition, the findings could help to guide better management of emergency medical situations and resources in their respective resource-constrained contexts. Furthermore, findings from the study could also guide better design and implementation strategies of EMS systems initiatives in South Africa and sub-Saharan developing countries.

1.10 Structure of the thesis

The thesis consists of 9 chapters and is organised in the following way.

Chapter 1: Introduction provides the background and introduction to the study. This chapter also discusses the goals, objectives and rationale of the research. The research questions are also presented along with overall overview of the entire study.

Chapter 2: Literature Review provides a review of literature of the research phenomenon.

Chapter 3: Critical realism This chapter provides a comprehensive discussion of CR as well as the fundamental assumptions of CR in IS research. This chapter provides a detailed discussion on why a critical realism perspective is undertaken for this study.

Chapter 4: Theoretical foundations reviews the different theoretical frameworks and discusses the choices used to investigate the research questions.

Chapter 5: Research design and Methods . This chapter provides a detailed outline of the design of the study as well as the method of the research.

Chapter 6: Contextualisation and Case description describes the case and contextual dynamics of the case.

Chapter 7: Data analysis discusses the analysis of the data

Chapter 8: Findings and discussion This chapter presents the findings and discusses these findings. A theoretical elaboration of the findings of the study is also provided. The model is developed using the analysis from chapter 7 and discussion in chapter 8.

Chapter 9: Conclusion is the final chapter of the study. This chapter analyses in retrospect the level to which the objectives of the study were attained. Moreover, the research questions are addressed in this chapter. Recommendations for future research are suggested.

Figure 1.1 below provides an illustration of the outline of the thesis.

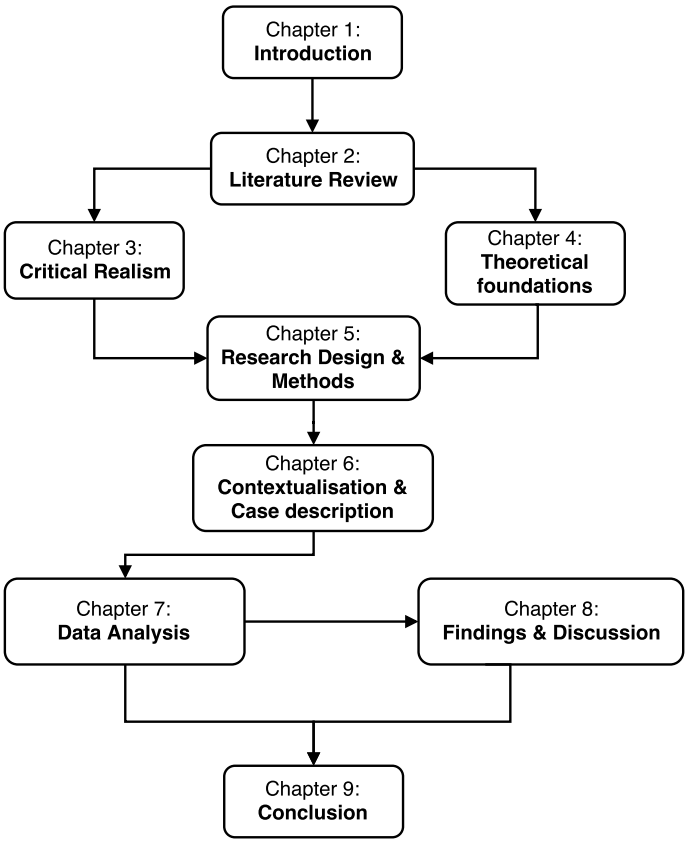

FIGURE 1.1: Research outline

Chapter 2

Literature Review

2.1 Introduction

The aim of this chapter is to review and synthesize literature on IT use and organisational performance within the context of EMS. The objective of the review is to discover the generative mechanisms of organisational performance as well as factors that explain IT-enabled organisational performance outcomes. The goal of the review is to develop a critical realist conceptual framework that forms a basis for proposing the research plan for the phenomenon of interest (Rowe, 2014). The review was accomplished by reviewing and analysing literature in the field of EMS systems and other closely related studies to the field.

To identify the relevant literature, an inclusion selection criterion was used. Peer reviewed articles from leading journals in the field were consulted. These in cluded PubMed, Information Systems Research, European Journal of Information Systems, Communication of the ACM, and MIS Quarterly.

This literature review followed a thematic analysis methodology (Webster & Watson, 2002). In IS literature reviews, as in many healthcare related reviews, thematic analysis is often used as a technique to synthesize literature (Leidner & Kayworth, 2006). Thematic analysis facilitates organising in a systematic fashion content of large volumes of text in order to identify the relationships between themes (Berg, 2004; Schryen, 2015).

To identify, synthesize and to find relationships between the different themes, a four phase argumentative strategy based on a CR perspective was used (Danemark et al, 2001; Okoli, 2012; Rowe, 2014; Rycroft-Malone et al., 2012).

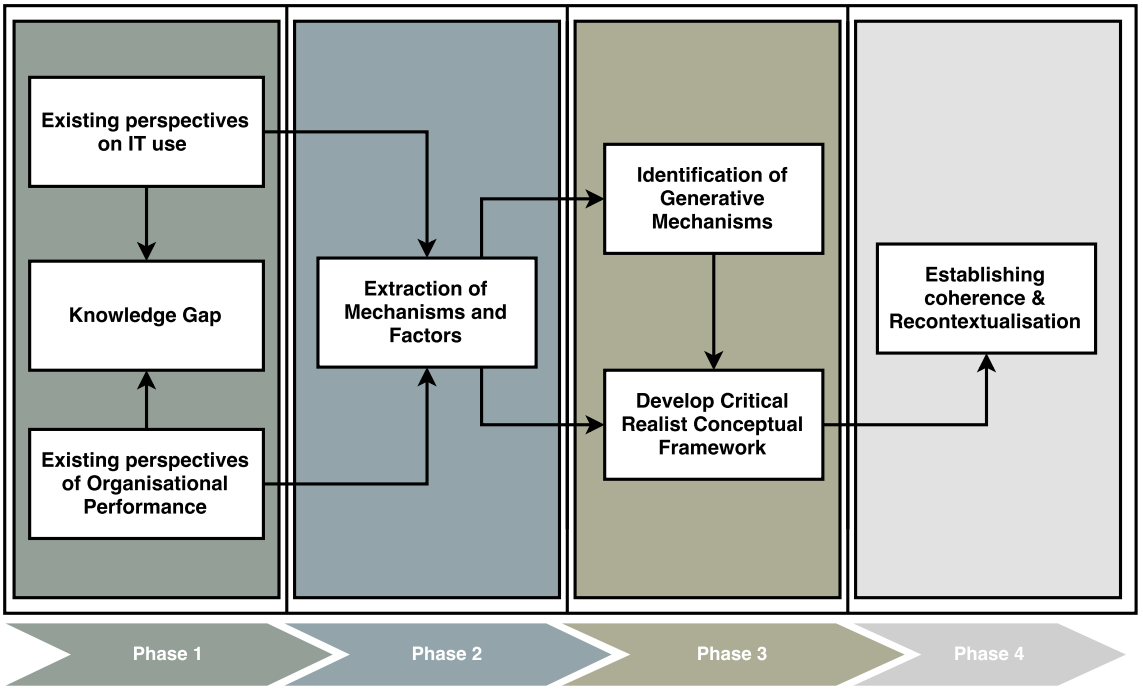

FIGURE 2.1: 4-phase critical realist review argumentative strategy Source:(Danermark et al, (2001); Ononiwu (2015);Rowe (2014); Okoli, 2012 and Rycroft-Malone et al., (2012))

The chapter begins by presenting a discussion on the existing perspectives on organisational performance in organisations. Thereafter, existing perspectives on IT use in Information systems is discussed, followed by a discourse on issues surrounding EMS systems usage culminating with the identification of the research gap within the literature. This structure is followed in order to gain a comprehensive understanding of the use of IT in resource con-strained EMS organisations to improve organisational performance.

2.2 Phase 1: Existing perspectives in literature

2.2.1 Defining IT use

Before exploring the definition of IT-enabled organisational performance, it is necessary to first define or at least establish the definition of "IT use" taken in

this study. "IT use" is a complex phenomenon that is difficult to define in isolation. Nan (2011, p.506), argues that the term "IT use" is frequently used in IS literature to embody an action that comprises of three fundamental aspects: firstly "users as subjects utilising the IT system"; secondly "IT features as building blocks or components of IT artifacts"; and thirdly, "tasks as functions being performed". Other studies define IT use as simply the interaction between users with IT artifacts and work tasks (Burton-Jones & Straub Jr, 2006; Jasperson, Carter, & Zmud, 2005). This interaction encapsulates users' acceptance of the characteristics or features of the IT artifact, the potential limitations imposed by the IT artefact on the users' behaviour, or compliance/defiance between the users usage behaviour and work tasks. Markus and Robey (1988) suggest an emergent perspective which is a result of "complex social interactions". They argue for a definition that includes "the uses and consequences of information technology as an emergent process where outcomes arise unpredictably from complex social interactions". In this study, a more comprehensive definition of *IT use* that includes both perspectives is adopted as it includes all the fundamental conceptualisations of IT use relevant to the study.

2.2.2 Existing perspectives on IT use in literature

Multiple perspectives have been used to study the IT use phenomenon in IS research (Schwarz & Chin, 2007). This is confirmed by literature synthesises which indicate the different dimensions and levels of IT use phenomenon in IS research which can be summarised into three dominant perspectives: (1) IT use at the individual level, (2) IT use at the group level perspective and (3) IT use at the organisational level perspective.

2.2.3 Theme 1: IT-use at Individual level perspective

In recent years, IT use phenomena has generated interest amongst scholars in the information systems domain (Abraham, Boudreau, Junglas, & Watson, 2013). This interest has largely been fuelled by the diffusion of IT in organisations and its implications on organisational outcomes (Rice & Leonardi, n.d.). A number of theoretical approaches have been employed to study the concept of IT-use

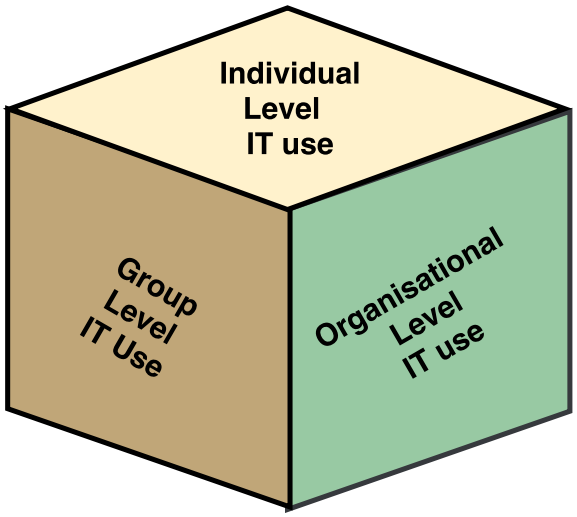

FIGURE 2.2: 3 dominant perspectives of IT use in literature

at the individual perspective. The majority of IT use studies have mostly relied on classical technology adoption and acceptance theories (Venkatesh, Morris, Davis, & Davis, 2003). The most dominant theories in the study of "IT-use" at the individual level are Technology Acceptance Model (TAM) and Unified Theory of Acceptance and Use of Technology (UTAUT) and their derivatives. These include Theory of Reasoned Action (TAR) and Theory of Planned Behaviour (TPB). These theories have mostly aimed to investigate the factors and antecedents that influence IT use (Taylor & Todd, 1995; Venkatesh & Davis, 2000). Over the years, these theories have been enhanced and used in different contexts to include multiple factors such as the intention to use, the attitudes that influence IT usage and a multitude of moderating factors (Venkatesh & Davis, 2000).

Recently, new conceptualisations that have used different theoretical approaches to study IT use have emerged. Examples include the Task Technology Fit (TTF) perspective, the Actor-Network perspective, Structuration theory perspective. However, the bulk of research studies synthesised suggest that "IT use" has been largely been used as the primary dependent variable with a host of other independent variables (Robey, Im, & Wareham, 2008).

2.2.4 Theme 2: Group level IT use perspective

With respect to IT-use at the group level, the dominant theories used include amongst others are activity theory, task-technology fit, theory of practice, and

social network theories (Oliveira & Martins, 2011). More recently, fresh new perspectives have emerged such as absorptive capacity theory and social materiality. For example, the materiality perspective argues that there are some characteristics of IT that are inherent to the technology and may not form part of the social context in which the IT is used (Leonardi & Barley, 2008; Orlikowski, 2007). IT plays an important role in promoting and facilitating interactions between different cross-functional and distributed teams in an organisation from various levels and organisational units (Aydin & Rice, 1992). In particular, IT enables new types of interactions between virtual teams in ways that brings about are collaborative efforts from the different teams (Black, Carlile, & Repenning, 2004; Burton-Jones & Grange, 2012; Butler, 2001). In particular, several studies revealed that IT can help foster better communication through improved coordination activities in order to reduce task complexity and conflict.

2.2.5 Theme 3: Organisational level IT-use perspective

Literature on the interaction between Information Technology (IT) and organisations points to two traditional views. These are the objective view and subjective view (Orlikowski, 1992). The first (objective view) considers IT an external force that has "deterministic impacts" on the structure of organisations (Orlikowski, 1992). This is also known as "technological determinism" view. While the second (subjective view); considers IT as an outcome of a human nature. This view argues that human action and interpretation of technology plays a significant role. Orlikowski (1992) argues that there are two important dimensions that converge to represent the complexity of IT usage in organisations. First is the scope of the artifact defined (i.e the essential elements constitute the technology) and secondly, the role played by IT in the organisation. With regards to the first dimension (the scope of the artifact) the dominantly proposed definitions in literature consists of two perspectives. The first perspective, IT is defined as a piece of "hardware". Orlikowski argues that, technology is considered an "artefact or the tools that humans use in "their productive activity". The second perspective, considers IT as "social technologies". Here, IT is understood to be part of the productive process, and comprises of the "general tasks, techniques and knowledge utilised when humans engage in any productive activity" (Orlikowski, 2008, p.399). In this research study, the definition of IT adopted is situated at the intersection of the two dimensions cited above, involving the

three main constitutive elements: The hardware (computers), software (the applications running on top of the hardware) and IT management services. With respect to the dominant theories used to study IT use at the organisation-level include for example institutional theory and structuration theory.

2.3 Existing perspectives on organisational performance

The concept of organisational performance is grounded on the belief that an organisation is the intentional assemblage of productive resources (human or material and/or capital), with an end goal of achieving a common purpose (Bharadwaj, 2000; Melville, Kraemer, & Gurbaxani, 2004b). The fundamental principle of performance lies in the value generation (Melville et al., 2004b). According to author Rice and Leonardi (n.d.) the main reason organisations implement information technologies is to "improve performance, whether at the individual, group, organizational or societal level".For any organisation, the creation of value can be defined as the necessary and sufficient performance standard that must be met within that organisation (Gebauer & Buxmann, 2000). There is often a reciprocal relationship between the value satisfactions relative to the resource allocations. Scholars argue that the sustained existence of organisations depend on the value generated by the use of the allocated resources (Ravichandran & Lertwongsatien, 2005). The value generated is in turn expected to exceed or at least be equal to the expected value generated by the allocated resources. However, there are conflicting debates in the literature regarding the definition of value. Some scholars argue "value is in the eye of the beholder" (Saunders & Jones, 1992). Different stakeholders in an organisation would typically have varying perspectives about what value represents to them, which would coincide with their purpose in that organisation.

Despite the many calls by organisational performance researchers for a more unified and objective definition of performance and what constitutes performance, performance remains a very broad and complex phenomenon. However, the multi-dimensional characteristic of organisational performance makes it difficult to define objectively. While many previous research studies have theorized the causal relationships between organisational performance and other

independent variables there remain no universal agreement on the definition of performance in literature. Synthesis of the literature on the concept of organisational performance confirms the multi-dimensional nature of organisational performance. There are varying perspective and approaches employed in different disciplines. For example, accounting, balanced scorecard, strategic management, entrepreneurship and micro-economic all have different definitions and adaptation of performance.

Nevertheless, the general consensus that exists in literature is that performance is a multi-dimensional concept. However, disagreements still persist on these different dimensions of performance and/or how they should be studied. To counter this multi-dimensional problem, scholars have often hypothesized causal models of organisational performance and tested them against different but specific performance measurement constructs. Unfortunately, this has resulted in another unintended consequence of lack of generalization because of the heterogeneity nature of performance measurement constructs. Performance as a phenomenon is one of the most widely studied phenomenon in most management disciplines (e.g., information management, economics, entrepreneurship, accounting, project management, etc). Despite this reputation, the exact definition of performance is often not always well specified. De Waal (2010) argue that performance should be action-driven as opposed to event oriented. However, the vast majority of literature refers to performance as both an event (obtaining performance) and action (an outcome).

2.3.1 Theoretical approaches underpinning organisational performance

General management literature on organisational performance has conceptualised performance to be made up of multiple dimensions. For example, in his seminal study, Drucker (1954) proposed a multidimensional performance framework that is critical to the existence and success of an organisation. Drucker's framework consists of eight dimensions which are are (1) productivity (2) market standing; (3) profitability; (4) worker performance and attitude; (5) manager performance and development; (6) physical and financial resources (7) public responsibility and (8) innovation. Similarly, Ansoff (1991) suggested in his study

that, Return On Investment (ROI) should ultimately be considered the ultimate measure performance criteria.

Over the years, research on the performance phenomenon has been informed by a wide-range of complementary theories from different disciplines. Given its multidisciplinary nature, Rummler and Brache (2012) argue that organisational performance can be divided into three fundamental levels: (1) The Macro or strategic level, (2) The process level and (3) Individual/job/performer level. Table 2.3 provides an illustration of the three perspectives.

Table 2.1: Summary of organisational performance studies

Existing perspectives on Organizational performance research			
Streams	**Theoretical view points**	**Key concepts**	**Reference examples**
The Macro or strategic perspective	Contingency theory Organisational theory , Modern organizational theory, Division of labor Systems theory	Formal organization structure, Leader-member relationship, Informal organizational structure,	(Donaldson, 2001), (Jones, 1995), (von Bertalanffy, 1973)
The process perspective	Bertalanffy (1956)'s General Systems Theory, Dialectical Systems Theory, Critical Systems Thinking, Viable Systems Theory	Large scale, complexity, uncertainty, impermanence, and imperfection.	(Rummler & Brache, 1990) (Goodhue & Thompson, 1995) Viable Systems Theory Flood and Jackson (1995) Beer (1984, 1985) Bammer (2003)
Individual/job/performer perspective	Goal-setting theory Agency theory Organizational theory	Role of Information Goal difficulty, Goal commitment, Goal acceptance, Task characteristics, Social or "People" control	(Eisenhardt, 1985) Locke & Latham's (2002)

2.3.1.1 Macro-level

The macro level consists of the strategic perspective, which in turn is comprised of themes that form a holistic approach to the management of the entire organisation. The strategic level is mainly concerned with the organisation's overall strategy, objectives and goals. The strategic level can be thought of as the blueprint of the organisation. Literature on organisation performance point to a number of performance management theories that often underpin the strategic level. Some of such theories include for example contingency theory (Donaldson, 2001), organisational stakeholder theory (Jones, 1995), general systems theory (Von Bertalanffy, 1968).

2.3.1.2 Process level

The Process level can be considered as the main linkage between organisational and individual performance (Rummler & Brache, 1990). The process level normally provides the greatest possibility for enhancing and improving performance. Scholars maintain that highly skilled individuals in an organisation may struggle to improve their individual performance levels if or when there are poorly designed processes (Goodhue & Thompson, 1995).

However, over the years, two critical and dominant dimensions have emerged in literature on performance specifically in information systems. These are: (1) efficiency dimension and (2) effectiveness dimension (e.g., Neely, Gregory, & Platts, 1995). Given that this study is focused on the healthcare sector, these dimensions are discussed below and are particularised to the EMS context.

2.3.2 Theme 1: organisational efficiency

Efficiency is generally measured as the comparative percentage of outputs versus the inputs. With respect to the efficiency dimension, most organisations operate within the boundaries of the resources available to them in order to provide services or goods. Efficiency can be said to be the benchmark to which organisations' outputs are measured against the resources available. Generally, two perspectives have been used to describe organisational efficiency. The first

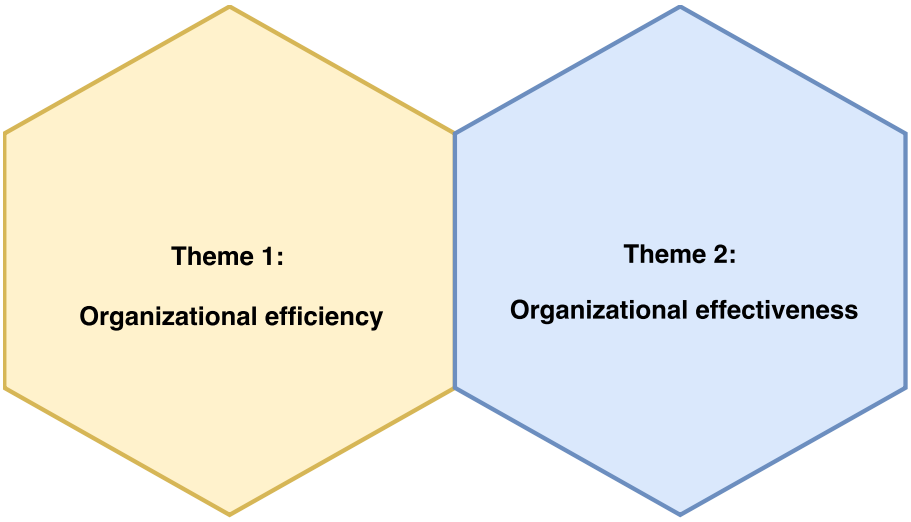

FIGURE 2.3: Dominant perspectives of organisational performance in literature

perspective is considered the standard method of defining organisational efficiency. This perspective creates associations between the resources used vis-Ăă-vis the outcomes produced. Organisational scholars argue that in order achieve efficiency, organisations should make sure that maximum outputs are derived from the input resources allocated (Pérez-López, Manuel-Montes Peón, & José-Vazquez Ordás, 2005). The first perspective also concerns the unit of production or services associated with the organisational goals and objectives.

The second approach is referred to as administrative efficiency. This approach concerns the various organisational processes contribute to the attainment of value in organisations. In contrast previous techniques of efficiency measurement that lead to result represented as ratios of return, administrative efficiency measures with relative levels of accuracy, an organisation's use of productive resources used versus the time invested managers and workers. This approach is related to the administrative costs associated with the production of those goods and services. Moreover, the administrative efficiency perspective is associated with an organisation's capability to align organisational structures (processes, policies and innovative efforts) by managing roles and responsibilities that enable or constrain human agents. In other words, administrative efficiency approach analyses the degree to which organisational structures help generate productivity in organisations.

2.3.3 Theme 2: organisational effectiveness

Organisational effectiveness refers to the near perfect condition of an organisation's, internal structures, processes and culture with respect to its performance indicators (Cummings & Worley, 2014; French & Bell, 1973; Khan, 1997). organisational effectiveness often captures various internal performance results related to with the effectiveness of operations internal to an organisation as well as some external measures that are linked to financial valuation (e.g., Share prices, reputation, etc.). organisational effectiveness dimension is considered a necessary and sufficient condition for organisations to achieve their objectives. March and Sutton (1997) state that, "Explaining variation in performance or effectiveness is one of the more enduring themes in the study of organisational performance". Nevertheless, determining and expressing effectiveness remains a challenging for most organisations. Brown and Perry (1994) argue that it is confusing for organisations to decide on a specific set of objectives or to agree on diverse sets of goals. Yet, despite these complications, organisations are still able to pursue effectiveness through various procedures and processes, to determine their objectives and goals, as well as to communicate to the different stakeholders, how effectiveness (performance) was attained.

2.3.4 Theme 3: IT-enabled organisational performance

More recently, the use of IT to support organisational performance in healthcare organisations has received increasing attention (Croteau & Bergeron, 2001; Melville, Kraemer, & Gurbaxani, 2004a). Organisational performance provides a framework for informed managerial decision making (Wu & Hu, 2012). In addition, performance enables the effective usage of resources (human and material) and acts as a medium through which employees or teams of in EMS organisations are held accountable for their actions (Peng et al., 2013). In particular, for EMS organisations, performance forms the basis for continuous improvement in delivering emergency services to the public (Schooley & Horan, 2007). From an EMS perspective, the primary purpose of organisational performance is to assist with decision-making and to hold various actors accountable.

Under the global theme of "health information systems", previous research studies in this domain have extensively discussed the link between IS/IT and organisational performance (Burke & Litwin, 1989; Melville et al., 2004a; Wu, Straub, & Liang, 2015). Scholl and Klischewski (2007) argue IT in organisations consists of a combination of a number of social and technical factors. Some of these factors include the time-critical characteristics of emergency services and the need for and delivery of timely as well as trustworthy information that is used by emergency paramedics in responding to emergency situations (Arens & Rosenbloom, 2003; Chan, Killeen, Griswold, & Lenert, 2004; Horan, Marich, & Schooley, 2006). Avgerou (2000, p.237) argues that "... IT is a pervasive technology, which impacts on all aspects of performance of organisations...".

In the context of EMS, IT is considered central to the functioning of most EMS (Chen, Sharman, Chakravarti, Rao, & Upadhyaya, 2008; Chen, Sharman, Rao, & Upadhyaya, 2007). Furthermore, IT is considered not only a tool that facilitates delivery of emergency services, but also an important strategic asset for EMS organisations. Not only does IT services provide a platform to which the business processes and other systems run, but also enables coordination of end-to-end technical as well as logistical business processes of delivering emergency services. These include for example information acquisition through call-taking, information processing, and ambulance dispatching. For resource constrained EMS organisations, organisational performance depends on the efficient and effective delivery of quality as well as timely emergency services which is ultimately underpinned by IT. Unfortunately, there were many different definitions of organisational performance from different disciplines (from Information systems, economics, etc.). Hence, the term "IT-enabled organisational performance" is used in this study to refer to the use of IT to support or underpin organisational performance in EMS organisations. This definition required well-defined constructs of both IT and organisational performance. The level of efficiency in healthcare organisations plays a significant role in determining organisational performance (Fottler, 1987; Ozcan, Luke, & Haksever, 1992). Hence, information systems have always been used to improve the organisational performance in many different industries. From a healthcare perspective; IT has been used to enable operations in different types of healthcare organisations hoping to improve performance (Chang & Wang, 2011; Mettler, Sprenger, & Winter, 2017). IT is therefore considered an important medium which facilitates provision of healthcare services given its influence on the efficiency of

operations (Chang & Wang, 2011; Safran et al., 1998).

For emergency organisations to perform well, they ought to be efficient in their operations (Jeong & Phillips, 2001). However, to achieve efficiency of operations in most healthcare organisations has never been an easy. Many health information systems adopters have recognised the need to make fundamental changes to their operations, in order to achieve transformation to meet their desired levels of efficiency (Fottler, 1987; Ozcan et al., 1992). Peng and Dey (2013) suggest the impact of IS adoption on operational efficiency are subject to variation depending on a number of issues. These include for example, the nature of medical work, the characteristics of the medical staff and the holistic system itself. Recent studies (e.g., Benner & Tushman, 2003; Vera & Kuntz, 2007) concluded that efficiency improvements can be achievable through collaboration at various levels between public and private emergency organisations. These include, integration at process level and information level. These include for example, the improvement of information flow, assisted and supported through information technology (Ball & Lillis, 2001; Haux, Ammenwerth, Herzog, & Knaup, 2002). In the context of EMS, to which this study is situated, the concept of "end-to-end" has been used to describe service performance across a number of interconnected events (Thomas, Friend, Dasilva, & Mackenzie, 2006). In the context of EMS involving multiple organisations, performance evaluation from service initiation to response and completion is crucial — this is described as "end-to-end" performance (Schooley & Horan, 2007). The term "end-to-end performance" is thus used in this study to describe the total performance of interlinked emergency response operations from service initiation (e.g emergency response phone call) and service acceptance and engagement, ambulance dispatching, on- scene emergency medical response, to service resolution, culminating with incident completion (e.g., ultimate patient care at a hospital). Horan and Schooley (2007) emphasise the importance of understanding end-to-end performance across an integrated network of organisations. The authors argue that, evaluating end-to-end performance across stakeholder public emergency service delivery organisations is necessary to improving delivery of public emergency services. These include the quality of service, the speed of service delivery, and how the inter-organisational information integration can further be improved to provide better services to the public.

2.4 Identification of knowledge gap

The performance phenomenon in organisations has been extensively studied both from both theoretical and empirical perspectives (Burke & Litwin, 1989; Lee & Choi, 2003; Melville et al., 2004a). However, existing literature on organisational performance have only gone as far as testing theories and analysing performance irregularities at the empirical level by (a) operationalising frameworks in different contexts and (b) developing descriptive as well as predictive models of performance.

Unfortunately, such studies and other approaches used in studying performance in existing literature have devoted very little attention to the causal mechanisms of organisational performance (Wood, Bandura, & Bailey, 1990; Wu et al., 2015). This is primarily because the majority of existing studies on the performance phenomenon aim to determine variables that yield changes in performance outcomes by defining organisational performance as a depended variable (March & Sutton, 1997). As a result, the causal structures associated with organisational performance outcomes have largely been ignored and unaccounted for. Moreover, existing research in the context of EMS systems in healthcare do not sufficiently incorporate relevant aspects needed to explore or to better explain the underlying causal mechanisms that enable performance outcomes as well as how IT enables organisational performance.

There are two fundamental research gaps identified by this literature review. These are the briefly described below.

2.4.1 Lack of sufficient studies on IT-use mechanisms

Despite a vast array of research studies on IT-use in organisations, the context of emergency medical organisations has not been adequately explored or explained. Literature review indicates three dominant perspectives undertaken by most studies on the IT-use phenomenon. The first perspective focuses on individual use level, the second on group and third at the organisational level. More recently, a number of studies have focused on finding irregularities, or seeking to provide descriptions of the value of information sharing across organisations by proposing prediction models and validating existing theories (Scholl, Kubicek, Cimander, & Klischewski, 2012; T.-M. Yang & Maxwell, 2011).

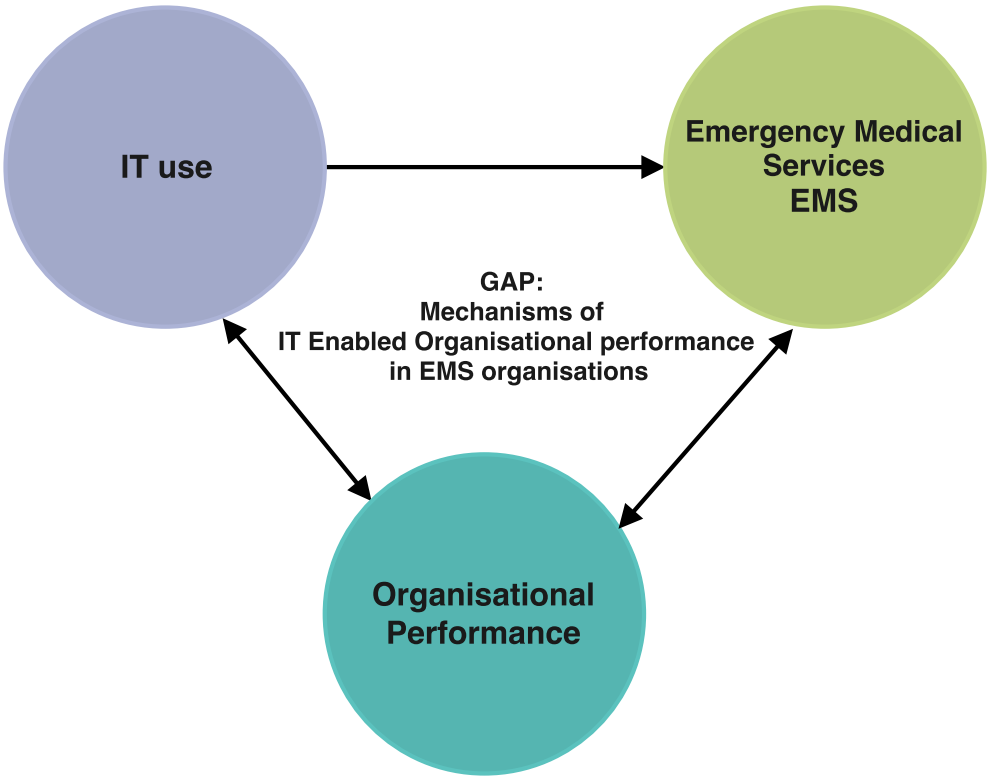

FIGURE 2.4: Research gap

On the basis of these existing studies, it is conceivable therefore, to explain IT-enabled organisational performance outcomes as a one reflected by the traditional views of IT-use in organisations; which can be situated along the lines of technological and organizational or social determinism. This static view suggests that technology use is the consequence of a number of processes comprising various factors and agents. This means that technology use in organisations to achieve a particular goal (in this case organisational performance) is mostly dependent on economic social and political factors. The limited existing theoretical explanations on the interactions between IT and healthcare organisations therefore necessitates to go beyond the traditional views of IT in organisations perspective to explore underlying causal mechanisms that contribute to the concrete outcomes (i.e improved performance outcomes with limited resources). Hence, traditional view of IT-use in organisation is static and insufficient because it fails to consider necessary deeper causal mechanisms, especially with respect to demi-regularities and contextual issues In other words, taking this static view would be in essence an epistemic fallacy (Archer, Bhaskar, Collier, Lawson, & Norrie, 2013).

2.4.2 Theoretical coherence and ontological limitations

The performance phenomenon in organisations has been extensively studied both from both theoretical and empirical perspectives. The performance phenomenon has gained considerable contributions from several fields including for example, strategic management, organisational theory, logistics and operation, as well as accounting and economics and finance. However, the problem is that the majority of these domains of knowledge have largely been studied in isolation. This in turn has generated heterogeneous theoretical approaches underpinned primarily by either the positivist or interpretivist paradigms which — as a result — have produced fragmentation of research findings that are often inconsistent and incongruent.

As clearly demonstrated in this literature review, the discipline lacks theoretical coherence resulting from the multitude of theoretical approaches used in investigating both IT use and organisational performance. Neither positivist nor interpretivist paradigms provide an ontology that includes the concept of transfactuality, i.e. the existence of causal structures with enduring properties, independent of human knowledge. Bhaskar (2008), argues that the absence of such an ontology about causality results in the implicit adoption of tacit ontology. Hence, the lack of a transfactual ontology as well as lack of theoretical coherence has limited the ability to produce objective explanations of causal mechanisms of desired performance outcomes in public EMS organisations.

2.4.3 Limitations in causal explanations of performance

Existing literature on organisational performance have only gone as far as testing theories and analysing performance irregularities at the empirical level by (a) operationalising frameworks in different contexts and (b) developing descriptive as well as predictive models of performance. Two categories of theoretical approaches have been used in this regard: 1) descriptive theories, and 2) normative theories. While descriptive theories have largely proposed hypothetical performance measurement relationships between, contexts of work, the workers behavioural attitudes, and work outputs; normative theories on the contrary intend to frame the standards of design for measurement systems aimed at generating desirable outcomes.

Unfortunately, such studies and other approaches used in studying performance in existing literature have devoted very little attention to the causal mechanisms of organisational performance. This is primarily because the majority of existing studies on the performance phenomena aim to determine variables that yield changes in performance outcomes by defining organisational performance as a depended variable. As a result, the causal structures associated with organisational performance outcomes has largely been ignored and unaccounted for. Moreover, existing research in the context of EMS systems in healthcare do not sufficiently incorporate relevant aspects needed to explore or to better explain the underlying causal mechanisms that enable performance outcomes.

2.5 Establishing a research agenda

On the basis of findings from the literature review, the limitations in existing research on IT use and organisational performance highlighted by the research gap can be summarized as (1) Lack of theoretical coherence and ontological limitations (2) limitations in causal explanations research on organisational performance in EMS organisations (3) lack of adequate research with specific focus on causal mechanisms of organisational performance in public health care organisations. As previously discussed in the review of literature, the various approaches used in existing research do not adequately address the changing nature of performance outcomes in public EMS organisations. Moreover, currently, there are no established standard methods for exploring or explaining the underlying structures and mechanisms that enable performance outcomes in public healthcare organisations — specifically, EMS organisations. To further extend current existing knowledge, a new approach that explains the underlying causal structures and mechanisms that contribute to performance outcomes in emergency medical organisations is necessary. Given that a close focus on the contextual dynamics, structures and mechanisms are are unaccounted for by existing research, the main research question was framed in the first chapter as:

- **What generative mechanisms explain IT-enabled organisational performance in resource constrained EMS organisations?**

The sub-questions are framed as follows:

- Why and how do the mechanisms produce the observed organisational performance outcomes in resource constrained EMS organisations?
- What contextual conditions exist and how do they influence IT-enabled performance mechanisms in the attainment of organisational performance outcomes?

The first step in an attempt to find answers to the main research question, a conceptual model from the synthesis of the literature was developed. Consequently, such a conceptual model acts as foundation for developing a mechanism explanatory based research model (Okoli, 2012; Ononiwu, 2015). This is discussed in the subsequent section.

2.6 Phase 2: Abstraction of mechanisms

The first phase identified the research gaps, the subsequent phase abstracts generative mechanisms from the main constructs or the relationships between the constructs from the identified themes in literature (Ononiwu 2015, Okoli 2012, Rycroft-Malone et al. 2012). Rycroft-Malone et al. (2012, p8) argue that, this phase involves "looking for chains of inference (connections) across extracted data and themes". This is done by following an iterative process to build/find relationships through the themes in order to develop a collective depiction of mechanisms.

Following Ononiwu, (2015); Barnett-Page and Thomas (2009) and Rycroft-Malone et al. (2012) initially, these key constructs were abstracted using thematic analysis coding consistent with the aim of the review of the synthesized literature. The synthesis of literature revealed that IT use and performance have been studied using a variety of approaches, which have generated vast and sometimes incommensurable findings. In looking at the identified themes through the a critical realist lens, exposes a number of generative mechanisms associated with organisational performance.

2.7 Phase 3: Identification of generative mechanisms

Scholars have previously studied the IT use in organisations from a complex adaptive systems theory perspective (Nan, 2011). The predictability of organisational performance in EMS organisations is limited given the intrinsic unpredictable and chaotic environmental dynamics governing operations of healthcare organisations. For example, it cannot be predicted when people will get sick or injured, or when accidents will happen. Emergency services response are reactionary to these environmental dynamics and contextual factors. These environmental dynamics therefore make it extremely difficult to predict the aggregate performance of EMS organisations responding and providing emergency healthcare services. To reiterate, in the healthcare sector, IT is used to facilitate delivery of EMS to the public.

The nature and extent of IT use in these organisations is complex. These complex linkages often involve dynamic, emerging, and unpredictable components. The nested socio-technical relationships suggest the need to re-examine IT-use in emergency medical organisations from a complex adaptive systems theory perspective. Such an approach is an essential conceptual step towards an explanatory model of the dynamic interplay between the the mechanisms at play in producing organisational performance outcomes. Furthermore, the CAS approach also signifies the need to investigate the different elements (e.g. agents, resources, IT-services, etc) in EMS organisations, as well as their complex interactions and arrangements.

2.8 Phase 4: Establishing theoretical coherence and re-contextualisation

The final phase of realist review involves translating the conceptual framework developed from the realist synthesis into "*...research avenues that capture the push beyond recognition of the research problem towards theorizing a solution*" (Ononiwu, 2015, p.94). The developed conceptual framework is initially considered in isolation from the context given that it (conceptual framework) illustrates the identified research gap, and some of the constructs identified may not necessarily be relevant to organisational performance or the EMS context. Therefore, to avoid

rendering concepts into the context where they are not applicable, two important steps are taken. First, the establishment of a theoretical coherence (Berman 2013; Matthyssens et al. 2013, Ononiwu 2015). This is done using the developed conceptual framework as a basis for establishing theoretical coherence. This is because the developed conceptual framework consolidates the interrelated theories reviewed that support the nature of reality in the context under investigation. Secondly, theoretical re-contextualization — by using the established theoretical coherence, along side empirical data, as an input process into the development of theoretical redescription of the research phenomenon (Bygstad & Munkvold 2016; Danermark et al. 2002, Ononiwu, 2015).

2.9 Chapter summary

The aim of this chapter was to review and synthesize literature on IT use and organisational performance within the context of EMS. The review applied a critical realist perspective to developing the synthesis of literature. Okoli (2015) argues that the aim of the realist approach is to distinguish "*... the latent theoretical concepts underlying apparently disparate empirical investigations to synthesize diverse yet commensurable primary studies*". In the end, the review formulated a critical realist conceptual framework that acts as a foundation for guiding the research plan for organisational performance. The chapter to follow presents the research philosophy guiding this research as well as theoretical approach of the study.

Chapter 3

Research philosophy: Critical Realism

3.1 Introduction

This chapter provides the necessary philosophical foundation for addressing the first research question namely, *What generative mechanisms explain IT-enabled organisational performance in resource constrained EMS organisations?*. Therefore, this chapter is concerned with the philosophical assumptions (ontological, epistemological and methodological considerations) guiding this research study.

The chapter is structured as follows; section 3.2 begins with a discussion on the two dominant research paradigms in information systems (positivism, interpretivism). Following that, a brief discussion on the limitations of both positivist and interpretivist approaches within the context of the study is presented in section 3.3. Thereafter, section 3.4 provides a discussion of the critical realist research paradigm. Section 3.5 summarises the fundamental critical realist assumptions while section 3.8 presents the rationale for choosing the CR as a suitable philosophy of science for underpinning the study. A summary of the chapter is presented in section 3.9.

3.2 Research paradigms in IS research

The term 'Paradigm' is defined by Webster dictionary as "an example or pattern: small, self-contained, simplified examples that we use to illustrate procedures, processes, and theoretical points". However, the concept of 'paradigm' has been widely interpreted differently by different scholars in information systems research. For example, Guba (1990) defines paradigm as "a set of beliefs and feelings about the world and how it should be understood and studied." Mingers (2001, p.242) defines paradigm as "... a construct that specifies a general set of philosophical assumptions".

There has been considerable debate and controversy on the classification of the main research paradigms in IS (Burrell & Morgan, 1979; Deetz, 1996; Hirschheim & Klein, 1989; Jones, 1983; Lincoln, Lynham, & Guba, 2011). This study adopts Orlikowski and Baroudi (1991) categorisation of a paradigm, which proposes three primary research paradigms underpinning IS research: 1) positivist, 2) interpretive, and 3) critical. This classification is mainly chosen because it has been widely accepted within the IS research community (Iivari, 1991; Klein & Myers, 1999; Ngwenyama & Lee, 1997; Segars, 1997).

3.2.1 Positivism

Positivism is the dominant philosophical approach that underpins research in the natural sciences (Schultze & Leidner, 2002). However, Mertens (1998, p. 8) argues that positivism is also applicable to social science research provided that "the social world can be studied in the same way as the natural world". He further notes that positivism can be applied in social sciences research on condition that a clear method is defined for studying the social world which should be value free, and that explanations of a causal nature can be clearly explicated. Early works by Hume consider causality to be associated with the recurrence between events (Beauchamp & Rosenberg, 1981; Strawson, 2014). For example, if two events x and y are repeatedly associated with each other, it can be hypothesised that event x causes y or vice versa. Hume's philosophical assertions have over the years influenced the positivist methodological traditions that advocate for the development of hypotheses. Additionally, prediction of findings

from empirical analyses is considered paramount to knowledge development and contribution (Kurki, 2008).

Perhaps the main similarity between the positivist and critical realist paradigms is the shared commitment to an objective reality that exists independently of humans. Positivism strongly stresses the importance of conducting empirical observations for deducing such causal properties, and emphasises that any conclusions reached, or knowledge claims proposed, about the natural world should only be applicable to those discovered events (Paré, Bourdeau, Marsan, Nach, & Shuraida, 2008). The shift towards predictive outcomes in IS research has largely been responsible for generating some naïve quasi-predictive theorising, such as the multitude of frameworks derived from the technology adoption model (TAM) and the likes. Nevertheless, such naïve theorising has recently been challenged as implausible and unnecessary (Markus, Majchrzak, & Gasser, 2002; Mutch, 2002).

The fundamental difference between the positivist and critical realist paradigms is that the positivist paradigm limits reality to 'things' that can only be observed, measured and correlated in order to produce 'objective' generalisations about reality. In other words, the positivist paradigm rejects those things that cannot be directly observed or measured. However, Bhaskar (2008, p.13,36) argues that this type of thinking about the social world is limited and constitutes what he terms an "epistemic fallacy" — a concept that refers to the implicit ontological assumption that reduces reality only to that which can be observed and measured. In spite of these challenges and critiques of the positivist tradition, IS scholars have yet to resolve the problem of the epistemic fallacy within their different epistemic approaches (Mingers, 2004b; Mingers & Standing, 2017).

3.2.2 Interpretivism

The interpretive research paradigm maintains that the nature of social reality in an open system is too broad a phenomenon to be reduced to simplistic representations (Orlikowski & Baroudi, 1991). That is because, interpretive research is mainly concerned with the study of the structures of human experiences and how humans make sense of the world (Walsham, 1995a). The interpretivist philosophy does not necessarily dismiss the positivist approach to knowledge enquiry, but instead interpretivism questions the positivist account of applying the

logic of scientific discovery from natural sciences to the study of the social sciences (Klein & Myers, 1999). In addition, the interpretivist paradigm indicates that, in contrast to objects in nature, humans have a tendency to alter their behaviour when they are aware of being observed (Walsham, 1995b). As a result, the interpretivist paradigm suggests that in order to explain social action, it is important to investigate the reasons and meanings humans ascribe to their actions (Chen & Hirschheim, 2004; Lee, 1991). However, with respect to causality, the interpretive paradigm is problematic because of its commitment to and continuous focus on human interpretations of reality. This close focus on individual interpretations in turn poses threats to causal explanations (Mingers, 2004a).

3.3 Limitations of Positivist and interpretivist paradigms

While the positivist and interpretivist paradigms have made significant contributions to knowledge, but these two paradigms (positivist and interpretivist) suffer from two important limitations (Archer et al., 2013).

The first limitation is that positivist and interpretivist philosophies advocate for a flat ontology, something Bhaskar calls '*ontological monovalence*' (Bhaskar, 2008). The problem with such philosophical thinking and advocacy for a flat ontology is that it implicitly assumes — for example, in positivism — that the only 'things' that exist are those that can measured (Carlsson, 2005; Easton, 2010; Mingers et al., 2013). In other words, according to positivism, those 'things' that cannot be measured cannot be considered to be real and therefore do not exist.

Meanwhile, the interpretivist tradition argues that the only things that can be known are those that make sense to humans, or things that can be expressed within the subjective perception processes of humans. Otherwise the interpretivist paradigm does not assume the existence of these things and cannot be considered to be part of the social world (Wynn & Williams, 2012). This places restrictions on what can or cannot be conceptualised about things that potentially exist but cannot be readily observed given the limited perceptions and sense-making of humans (Mingers et al., 2013; Sayer, 2000).

Secondly, neither positivism nor interpretivism acknowledge or allow for the prospect of transfactuality (Bhaskar, 1998). This is the notion that causal mechanisms; a) may exist with or without being recognised by humans (Mutch, 2002),

and b) may exist without being triggered by events (Bhaskar, 1998, 2013). Table 3.1 provides a summary of the contrast between positivist, interpretivist and critical realist paradigms with the respective ontological, epistemological and methodological assumptions.

Table 3.1: Contrast of philosophical assumptions

Philosophy	**Positivism**	**Interpretivism/ Phenomenology**	**Critical Realism**
Ontology	Reality is objective and singular, apart from the researcher	Reality is subjective and multiple as seen by the participants	Stratified ontology: Real, Actual, Empirical
Epistemology	Researcher is independent from that being researched	Researcher interacts with that being researched	Modified Objectivist: Findings are probably true
Methodology	Cross-sectional studies Experimental studies Longitudinal studies Surveys	Action Research Case Studies Ethnography Grounded Theory Hermeneutics,	Case Studies: Multi-methods Abduction, Retroduction

Given that science allows us to determine correlations and causation through experimental methods, Bhaskar argues that there must be some underlying causal structures and generative mechanisms that enable observed events to be measured. However, since these correlations may not hold in an open system (as opposed to closed system), Bhaskar (1998) maintains that the actual generative mechanisms that give rise to the observed events should be distinguished from the produced outcomes or events. This means that causal mechanisms possess enduring properties that are continuously operating, irrespective of any direct effects. Additionally, Bhaskar (2008) argues that these causal mechanisms can be considered real if they produce any effect (i.e. by giving rise to some observed outcomes). Hence, CR goes beyond these two limitations of positivist and interpetivist philosophies by introducing the concept of transfactuality (Bhaskar, 2008). Bhaskar proposed transfactuality as a way to deal with such limitations by considering causal mechanisms to be real and existing irrespective of humans' limited perceptions and interpretations.

3.4 Critical realism

CR is a philosophy of science that acknowledge the transfactual existence of structures that have causal powers. These causal structures are often referred to as mechanisms (Fletcher, 2017). CR seeks to develop explanations for particular outcomes that are generated by the underlying mechanisms (Bygstad et al., 2016). To do this, CR allows to transcend these mere descriptions of events, and to recognise the role of structure and agency (Wynn & Williams, 2012). The interaction between agency and structure as well as the responsiveness to real complexity defines critical realism as an explanatory approach (Mutch, 2002). Furthermore, CR recognises the factors that exist both in human actors and in contextual factors (Danermark et al., 2001). Events that emerge are not only a result of the actions of individual agency but also a result of contextual factors (Dobson, Myles, & Jackson, 2007).

CR posits an independent reality that can be fallibly known (Mingers, 2004b). In other words, the nature of reality is independent of human beliefs and accounts as well as of observations that humans make of the world. Central to Bhaskar's realist philosophy of science is the question: "*What must the world be like in order for science, as we understand it, to be possible?*"

In essence, CR seeks to provide explanations that go beyond descriptions and predictions about the nature of reality to account for and explain the factors that are interacting and emerging to cause changes in the observed phenomenon (Archer et al., 2013; Bhaskar, 2008; Dobson et al., 2007). One distinctive feature of CR is the three-level stratification of its ontology (Wynn & Williams, 2012). These three levels of reality are known as the domains of the real, the actual and the empirical (Bhaskar, 2008). The underlying philosophical assumptions underpinning the critical realist research paradigm are tied to three primary principles: a) ontology, b) epistemology and c) methodology.

The section to follow introduces the fundamental assumptions of CR.

3.5 Critical realist ontological assumptions

Ontology mainly refers to the nature of social reality (Guarino, 1998; Mingers, 2004b). Ontology incorporates the fundamental assumptions that are made with respect to the basic components of reality, which in turn are situated within the domain of scientific inquiry (Fleetwood, 2005). In contrast to the traditional positivist and social constructivist world views that tend to reduce reality to that which can be empirically observed and measured — the critical realist ontology argues for the existence of reality that is absolute or relative and independent of humans ability to discern (Archer et al., 2013; Bhaskar, 2008; Mingers, 2004b; Sayer, 1992) .

Furthermore, Mingers et al. (2013) argue that "CR accepts the existence of different types of objects of knowledge — physical, social, and conceptual — which have different ontological and epistemological characteristics". These involve a wide variety of research methods to discover and retrieve them.

The realist ontology is stratified into three distinct domains of reality. These are the domains of the empirical; the actual and the real (Archer et al., 2013; Mingers, 2004b; Wynn & Williams, 2012).

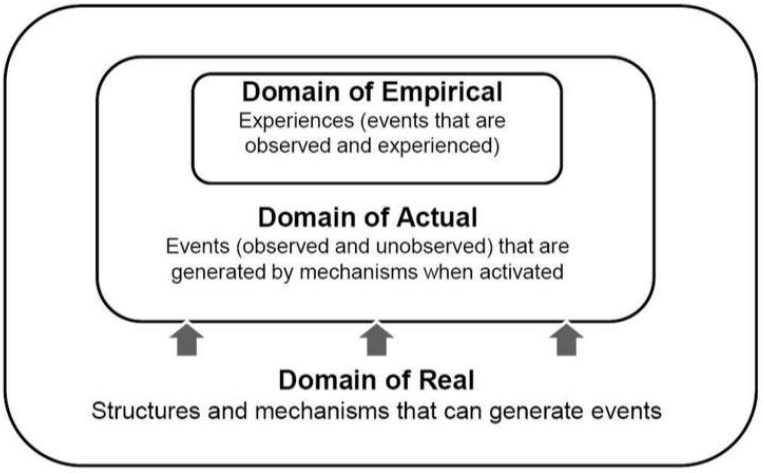

Figure 3.1: Critical realism domains of reality. (Adapted from Mingers, 2004)

As illustrated by Figure 3.1 above, fundamentally, the ontology of CR is transcendental (Bhaskar, 2008), meaning there is a clear distinction between the three

domains of reality. This means that the nature of reality is objective and certain properties of this reality that are not necessarily observable (Avgerou, 2013).

The domain of actual includes mechanisms that generates the observed outcomes experienced in the empirical domain. While the domain of empirical include observable experiences (outcomes). These experiences or outcomes are acquired by direct observations (Mingers, 2004b). When these mechanisms are triggered, they generate some outcomes. The triggering of these mechanisms take place in the domain of the "actual". However, these events may or may not be directly observable by human observers — because of humans limitations of perception, or because of interference and concealing by other counteracting events (Dobson et al., 2007). Actual events, which are observable, by human observers are referred to as "empirical" (Collier, 1994). Therefore, real mechanisms or powers can produce actual events, which may or may not be empirically perceptible.

3.5.1 Events

Events are known to be detailed actions or occurrences that are direct or indirect consequence of an interplay of mechanisms. Bhaskar (2008) maintains that events are characteristically and ontologically different compared to the structures and mechanisms that cause them. Since events are the outcomes of the interplay between causal mechanisms arising from the underlying structures, it may possibly occur that no change may arise as a result of opposite effects of the interacting mechanisms (Wynn & Williams, 2012). Moreover, it may be conceived that the resulting effects of the mechanisms may intensify the outcomes of other mechanisms, which might result in an increased in magnitude, the ability to be recognized and the outcome direction of actual events (Wynn & Williams, 2012). Despite the fact that many events maybe generated as a result of structures and mechanisms, CR epistemology acknowledges the limited ability humans have to recognize and measure them. Wynn and Williams (2012, p. 792) argue that "This is especially true for complex events which are less likely to be directly perceived." However, the events maybe known through the abstraction from their effects instead of the limited perception humans have.

3.5.2 Causal mechanisms

The term causal mechanism is used to refer to a set of entities, elements and/or activities that produce some observed change from a set of initial conditions (Archer et al., 2013). Mechanisms are the building blocks that are used to generate causal explanations of a particular phenomenon of interest. In addition, mechanisms serve as the intermediate links by which the observed outcomes are attained (Archer et al., 2013).

Collier (1994, p.62) defines mechanisms as as " that aspect of the structure [or entities] by virtue of which it has a certain power". However, Astbury and Leeuw (2010, p. 368) define mechanisms as "*underlying entities, processes, or structures which operate in particular contexts to generate outcomes of interest*". From a critical realist perspective, mechanisms have three fundamental characteristics. These are:

1. Mechanisms are usually not directly observable;
2. Mechanisms are sensitive to variations in context; and
3. Mechanisms generate outcomes.

The domain of real includes the mechanisms that generate the actual events. Generative mechanisms exist individually but have a propensity to produce patterns of particular events under specific conditions (Bygstad & Munkvold, 2011; Mingers, 2004b). These patterns take place in the domain of the actual. However, they may or may not be observable.

Bhaskar (2013) and (Collier, 1994) note that generative mechanisms possess the following important characteristics: First, they have the propensity to be activated (or not) by some events and or other mechanisms. Secondly, mechanisms are typically not directly observable apart when they manifest in their effects. Finally, mechanisms are generally studied as a part of a group or collective action instead of individual elements (Archer et al. 1998; Bhaskar 2013). Avgerou (2013) argues that these fundamental characteristics of mechanisms are a "*direct consequence of the distinctive combination of ontology and epistemology in critical realism*". CR aims to transcend mere descriptions and/or reflections of reality, in order to understand and explain why certain structures are organised and how

Table 3.2: Summary of mechanism definitions adapted from (Hedström & Ylikoski, 2010)

Definition	Reference
A causal mechanism is (i) a particular configuration of conditions and processes that (ii) always or normally leads from one set of conditions to an outcome (iii) through the properties and powers of the events and entities in the domain of concern.	Little (2011)
Underlying entities, processes, or structures which operate in particular contexts to generate outcomes of interest"	Astbury and Leeuw (2010)
A generative mechanism ... is that aspect of the structure [or entities] by virtue of which it has a certain powers.	Colliers (1994)
Generative mechanisms are what make "things" happen in the world.	Danemark (2002)
[Mechanisms] ... are the intransitive objects of scientific theory. They are quite independent of men--as thinkers, causal agents and perceivers. They are not unknowable, although knowledge of them depends upon a rare blending of intellectual, practico-technical and perceptual skills. They are not artificial constructs. But neither are they Platonic forms. For they can become manifest to men in experience.	Baskhar (2013)

they function, in order to theorise the structures and mechanisms that give rise to observable events (Bhaskar, 2008). As such, in this study, the view of generative mechanism adopted is that of Blom and Morén (2011), which describes generative mechanisms as "…a trans-empirical but real existing entity, explaining why observable events occur". This view is necessary because it allows to consider generative mechanisms in the context of this study as the underlying causal structures that explain the observed relationship between IT-use and organisational performance in the context of resource constrained EMS organisations.

3.5.3 Structures

CR argues for a realist focus on context and setting (Bhaskar, 2008). This means that an in-depth analysis carries the focus beyond the observable outcomes at the empirical level, to investigate the structural relationships that exist between

the structures and agency. These relationships may play an influencing causal role without the awareness of the different actors involved (Sayer, 2000).

Hence, structures are defined in CR as a group of internally connected objects or practices (Sayer, 2000, p.92) that are comprised of the real entities which can be studied in a specific context. A given set of structures may form part of higher level structures, and may comprise substructures and numerous other elements.

3.5.4 Emergence

Critical realist ontology takes into consideration the different structural powers that enable and/or constrain actors' behaviours (Archer et al., 2013). This is despite the non-occurrence of events expected to arise from these structures, or conversely, the events had occurred but were oblivious to actors (transfactuality) (Fleetwood, 2005). Such structural powers can be said to be emergent. Figure 3.2 provides an illustration summary of the relationship between structures, mechanisms and events. CR helps to provide explanations that move beyond descriptions and predictions about the nature of reality, to account and explain the factors that are interacting and emerging to cause changes in the observed phenomenon (Danermark et al., 2001).

3.6 Critical realist epistemological assumptions

Epistemology attempts to address a number of fundamental questions related to the nature of knowledge and about what can be known (Myers et al., 1997). Epistemology is concerned with the nature and foundations of knowledge, the degree of validity and its primary underlying assumptions vis-a-vis the social world in which the knowledge is manifested or used (Hirschheim, 1985). In IS research mainly, epistemology seeks to find answers to fundamental questions about knowledge, the connection between the researcher and the knowledge, the methods of enquiry about knowledge itself (Hirschheim, 1985; Mingers, 2001; Myers et al., 1997). Furthermore, epistemology aims to ascertain what can be considered as knowledge, (Krauss, 2005, p. 759).

Critical realist epistemology allows to generate explanations of reality based on investigations derived from human experiences, in combination with different

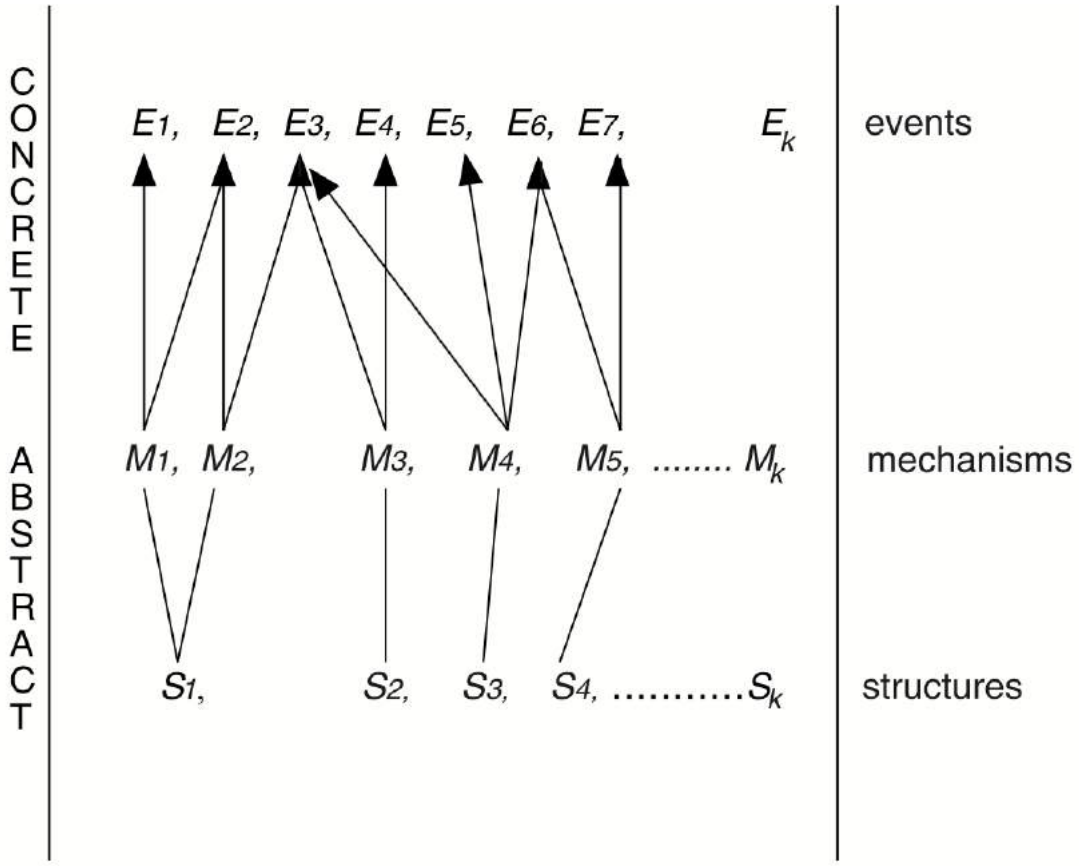

FIGURE 3.2: Structures, mechanisms and events. (Source: Sayer (2010))

types of data. Wynn and Williams (2012) argue that the knowledge claims are developed from events and experiences under investigation. These are mainly focused on providing explanations of the rudimentary components of reality that ought to exist to enable the emergence of the observed events. CR epistemological assumptions are mainly guided by the notion and assumptions of a critical realist stratified ontology. Central to CR epistemology, are a number of principles that are essential to CR principles. These are 1) explanations via mechanisms, 2) unobservability of mechanisms and 3) multiple/competing possible explanations for mechanisms (Bhaskar 2013; Collier 1994; Sayer 1992). These are discussed below.

3.6.1 Explanations via mechanisms

CR seeks to go beyond mere descriptions about nature of reality to find answers to the question "why" is reality the way it is. However, asking the "why" question is not aimed at providing descriptions of the world (Mingers et al., 2013). Moreover, it is less about providing predictions, nor interventions. The objective is to provide clear, concise and empirically supported explanations of causation, that is, why and how a phenomenon occurred (Bhaskar, 1998).

3.6.2 Unobservability of mechanisms

Realism asserts that, there are real underlying causes, structures, processes and entities that give rise to the observations humans make of the world. CR argues because of the existence of a causal world (underlying structures and generative mechanisms) independent of the socially constructed human reality, mechanisms may not be directly observable (Bhaskar, 1998).

3.6.3 Possible alternative/competing explanations for mechanisms

Given that the goal of CR-based research is to provide explanations rather than predictions (Mingers, 2003), CR recognises that causation is fundamentally heterogeneous over multiple kinds of mechanisms and structures (Wynn & Williams, 2012). Many factors come together to generate outcomes that can be observed in the real world. However, a small change in one of these factors could lead to bigger changes or a massive phase shift in events taking place. This is because of the complex nature of reality. The universal interaction between these different entities both extensive and intensive infers to possible alternative explanations of mechanisms that can be postulated (Mingers, 2001). However, CR acknowledges the unavoidable shortcomings of some explanations, and thus recommends that the researcher should be mindful of the limitations of some explanations (Sayer, 2000). Hence, CR's stratified ontology (Empirical, Actual and Real) allows for a broader and flexible epistemic approaches and appreciates the different, competing explanations of mechanisms.

3.7 Critical realist methodological assumptions

By definition, methodology refers to a set of principles, techniques or procedures on how to collect and validate information about a particular phenomenon (Lee & Hubona, 2009). The realist methodological approach is based on the assumption that there exist underlying causal mechanisms that caused an observed phenomenon. The aim is to gather the necessary and sufficient empirical facts about that particular phenomenon to be able to make theoretical statements about the underlying mechanisms at work (Archer, 1995). The methodological choice is primarily guided by the epistemology and ontology existing within the research domain of interest. Table 3.3 provides a summary of the philosophical assumptions in the context of the critical realist research paradigm.

	Ontology	**Epsitemology**	**Methodology**
Realist Assumptions	Stratified ontology: Real, Actual, Empirical	Modified Objectivist: Findings are probably true	Case Studies: Multi-methods

Table 3.3: CR philosophical assumptions

3.8 Rationale for choosing Critical Realism

Critical realism is relevant in IS because it enables researchers to take a realist viewpoint while acknowledging the critiques of naive realism. CR addresses both natural and social science and therefore involves the application of various methods and approaches (hard and soft) (Mingers, 2001). Moreover, according to Mingers (2003), CR fits well with the reality of IS as an applied discipline.

CR posits that a given phenomenon posses some hidden powers that are enacted through a set of mechanisms or powers as a result of their basic structural characteristics (Fleetwood, 2005). In the context of this study, IT-enabled organisational performance is the outcomes observed/experienced in the domain of the empirical. These powers and mechanisms are enacted in the domain of the actual and may not be easily apparent to the as observed or experienced in the empirical domain. This is primarily because of the limited perceptions humans have to assimilate the experienced outcomes (Bhaskar, 2008). Therefore, real

powers sometimes are enacted to generate actual experiences, and these experiences might or might not be empirically observable. However, some events are observable by humans and these take place in the domain of the empirical (Mingers et al., 2013). Figure 3.3 illustrates the ontological stratification in the context of the study.

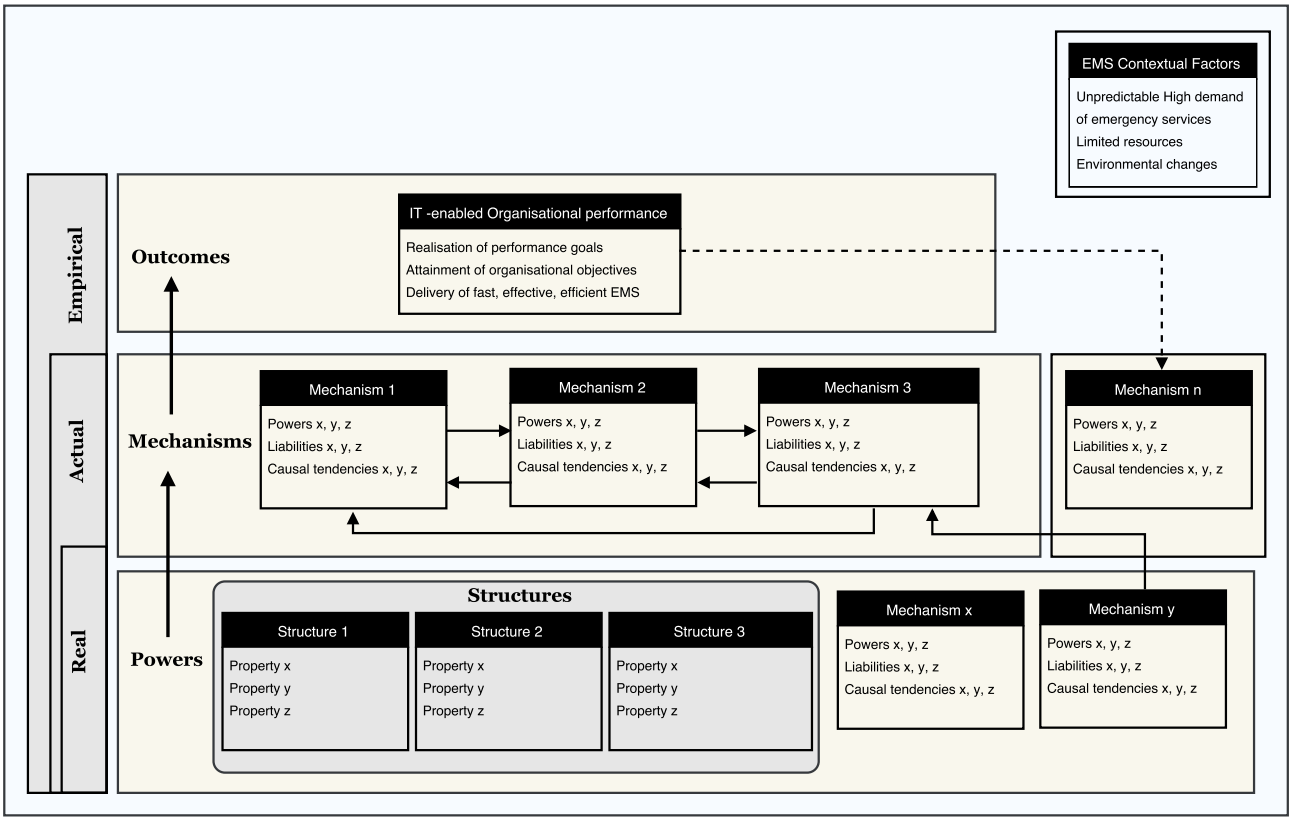

FIGURE 3.3: Conceptual model for Identification of Mechanisms

Furthermore, CR philosophy is relevant to the study of IT-enabled organisational performance in EMS organisations for two fundamental reasons:

First, CR allows to establish strong ontological foundations given its stratified ontology (Bhaskar, 2013). Although there is definite value in previous approaches underpinned by positivist approaches, however, such approaches mainly suffer from epistemic fallacy (Bhaskar, 2013; Danermark et al., 2001). CR argue that the positivist approach of hypothesizing and testing of correlations between constructs neglects or ignores the independent role of the context which cannot be separated from a social phenomenon. In so doing, Danermark et al. (2001) argue that research guided by positivist assumptions tend to generate 'thin' descriptions of research phenomena, and lack thick explanations of empirical events.

Hence, CR places a strong emphasis on a realist focus on context and setting (Bhaskar, 2008). For example, positivist research might possibly claim that IT use is positively correlated to improved organisation performance. Yet, this means that, positivists would often fail to acknowledge the underlying IT use structures and mechanisms that exist, which may or may not, explain why and how these IT use and organisational performance are mutually related. This is because positivist and interpretivist approaches do not distinguish their ontological views from their epistemic roots (Danermark et al., 2001).

From a CR perspective, it is possible to argue that there may be various 'identifiable' factors of why IT use might be linked with improved organisational performance. However, these identifiable 'factors' may have little to do with improved organisational performance outcomes being caused by IT use. These causes may include for example, human resource issues such as, organisational structural issues or various external factors which may result in improved organisational performance. Alternatively, for instance the causal relationships between IT use and improved organisational performance may be both generated by a third factor (such as the nature of business processes, or resources, technological affordances, etc.), whereas they (IT use and improved performance) may actually have indirect causal relationships generated by other mechanisms. As a result, enquiry of IT-enabled organisational performance outcomes in EMS organisations from a positivist standpoint — risks ignoring from its theorizing — the underlying mechanisms which may be not be directly observable, nor actualized.

Secondly, the interpretivist philosophy may not be suitable for enquiry into performance outcomes because of the way it considers the essential issues of philosophy resulting from the contextual conditions (Wynn & Williams, 2012). This is mainly because implicit ontological assumptions within the interpretive philosophy which argues that reality in the social world is rather conceptual, with 'meanings' — ascribed by actors — being the central focus of interest. Instead, CR facilitates the discovery of reality existing independent of the researcher's potential bias stemming from his/her own preconditions and judgements. CR makes this possible by acknowledging the relativism of knowledge associally and historically embedded in the epistemic domain (Dobson et al., 2007). Hence, an in-depth analysis carries the focus beyond the observable outcomes at the empirical level, to investigate the structural relationships that exist between the

structures and agency. These relationships may play an influencing causal role without the awareness of the different actors involved (Sayer, 2000). Hence, a CR approach is necessary in this regard because it asks "why" in order to provide explanations of the causal mechanisms that lead to the observed performance outcomes.

In summary, CR thus provides the opportunity move beyond the existing limited debates in positivist and intepretivist philosophical traditions in order to strengthen the philosophical underpinnings into the enquiry of the causal factors or mechanisms that have the powers to produce IT-enabled organisational performance outcomes in emergency medical organisations.

3.9 Chapter summary

This chapter first provided a detailed discussion which distinguished the positivist and interpretivist from critical realist philosophy in IS research. Recognising the limitations of the positivist and interpretivist paradigms, this research study discussed the fundamental principles of critical realism (ontology, epistemology) and then presented the rationale for choosing critical realism as a suitable philosophy for guiding this research. The chapter to follow discusses the theoretical foundations underpinning the study.

Chapter 4

Theoretical foundations

4.1 Introduction

This chapter describes the main theories that consider performance from an organisational perspective. The critique of these theories acts as a backbone for the research on performance in EMS organisations. In the light of CR, as expounded in the previous chapter, IT-enabled organisational performance is considered to 'emerge' from an interplay between structures and mechanisms in EMS organisations. The aim is to develop a theoretical foundation which provides a basis for the research design in Chapter 5.

This chapter is structured as follows: section 4.2 discusses the background and nature of theory in critical realism and information systems research. After that, a review and critique of relevant theories are provided. These are the Burke-Litwin organisational performance framework in section 4.3, the Time Critical Information Services theory in section 4.4, the Complex Adaptive Systems theory in section 4.5 and Institutional theory in section 4.6. The penultimate section 4.7 provides a discussion on the integration of the two chosen theories. The chapter concludes with a summary in section 4.8.

4.2 Background of the nature of theory in Critical Realism and information systems

Theory in critical realism enables a focus on explanations of underlying mechanisms that give rise to the observed events in the domain of the empirical (Okoli, 2012). The three domains of reality (Real, Actual, Empirical) in critical realism are well connected to theory (Easton, 2010; Wynn & Williams, 2012). Collier (1994) characterizes two forms of explanations that are central to critical realist theoretical investigation: a) horizontal explanation and b) vertical explanation. Collier argues that horizontal explanations explain events through mechanisms together with their preceding causes, while vertical explanation are the "explanation of one mechanism by another, more basic one" (Collier, 1994, p. 48).

The fundamental principle of theory in CR maintains that real mechanisms have latent powers to produce actual events in the real world (Astbury & Leeuw, 2010; Avgerou, 2013). These events may or may not be observed in the empirical domain (Okoli, 2012). The main consideration is typically the concrete outcomes that are produced. Consequently, an inquiry into generated events involves detecting enabling conditions that allow for both the manifestation of these events as well as their empirical observation (Okoli, 2012). The observations allow researchers to theorise about the underlying mechanisms or laws that caused the observed events (Bygstad & Munkvold, 2011).

In IS research, there are several definitions of the term "theory" (Gregor, 2006). Most of these definitions have been formulated from either a positivist or an interpretivist perspective. The majority of these definitions are incompatible with critical realist principle of horizontal explanation. Critical realist assumptions focus more on explanations. As a result, this study adopts Okoli's (2012, p. 9) definition of theory:

> Theory is an "*An integrated collection of explanations about the relationship between one or more pairs of concepts that represent real-world phenomena under specified conditions; such explanations might be accompanied with predictions and implications for intervention and action*".

This definition is adopted for two reasons. First, it is consistent with critical realism's notion of a transcendental reality. Secondly, it includes the notion of

both horizontal and vertical explanation Collier (1994). Although this definition includes the notion of prediction, Okoli (2012) argues that prediction is only a sufficient but not necessary condition in this regard. On the other hand, explanation is "an indispensable part of any theory".

Gregor (2006, p. 611) provides a taxonomy of five different theory types in IS research as shown in Table 4.1. According to Gregor, these are "Type 1: descriptive theories (theories for analysis); Type 2: theories of explanation; Type 3: theories for prediction; Type 4: theories of explanation and predictions; and Type 5: theories for design and action. Okoli (2012) notes that, while these different types of theories are valuable in their application to different research contexts, only theories of explanation are valuable and relevant to critical realist research.

Table 4.1: Typology of theories in IS research. Adapted from (Gregor, 2006)

Theory Type	**Distinguishing Attributes**
Theory of analysis	Says what is. The theory does not extend beyond analysis and description. No causal relationships among phenomena are specified and no predictions are made.
Theory of Explanation	Says what is, how, why, when, and where. The theory provides explanations but does not aim to predict with any precision. There are no testable propositions.
Prediction	Says what is and what will be. The theory provides predictions and has testable propositions but does not have well-developed justificatory causal explanations.
Explanation and prediction (EP)	Says what is, how, why, when, where, and what will be. Provides predictions and has both testable propositions and causal explanations.
Design and action	Says how to do something. The theory gives explicit prescriptions (e.g., methods, techniques, principles of form and function) for constructing an artifact.

Four theories that consider performance from an organisational perspective are reviewed based on the definitions above and the notion of theory from the critical realist perspective. The four theories are: 1) the Burke-Litwin framework of organisational performance and change; 2) Time-Critical Information Services (TCIS); 3) The Complex Adaptive Systems (CAS) theory and 4) Institutional theory. The rationale for the choice of CAS and institutional theory as having the potential to explain the mechanisms that give rise to IT-enabled organisational performance in EMS organisations is provided in the last section of this chapter.

4.3 Burke-Litwin organisational performance and change model

The Burke-Litwin model of organisational performance and change is a systems science model grounded on the principles of cause and effect (Martins & Coetzee, 2009). The Burke-Litwin model describes the relationships between key factors which postulate how organisational performance is manipulated (through internal and external factors), as well as how desired organisational change can be influenced (Burke & Litwin, 1989).

The model consists of factors and intricate relationships that indicate some causal relationships between the internal and external organisational environment. The relationships between these factors are intended to provide explanations of how the factors are linked to organisational change and performance (Burke & Litwin 1989; Burke, 2013).

The practical value of the Burke-Litwin model lies in the analysis and prediction of organisational behaviour and performance outcomes. The causes are organisational factors, while 'effects' are performance outcomes. These factors guide the analysis of organisational performance, as well as desired organisational change (French, Bell, & Zawacki, 1989). The Burke-Litwin model is considered by many scholars to be a good indicator of the internal state of organisational climate within organisations. Kraut (1996) considers the Burke-Litwin model to be a feasible theoretical guide for enhancing the effectiveness of an organisation's internal functions by prescribing possible actions for enhancements. Figure 4.1 provides an illustration of the Burke-Litwin model. The model starts by representing the external environment, which acts as an input into the organisation. The end result or output is the individual and organisational performance.

The Burke-Litwin model emphasises two essential organisational dynamics: (1) transactional dynamics and (2) transformational dynamics (Burke & Litwin, 1989). Transactional organisational dynamics are associated with the daily transactional interactions and exchanges that occur at the level of human behaviour. Transactional factors are classified as management practices, structure, systems and work unit climate. The interactions between these factors promote the mood and climate under which employees contribute to change and performance in an organisation (Burke & Litwin 1989; Burke, 2013).

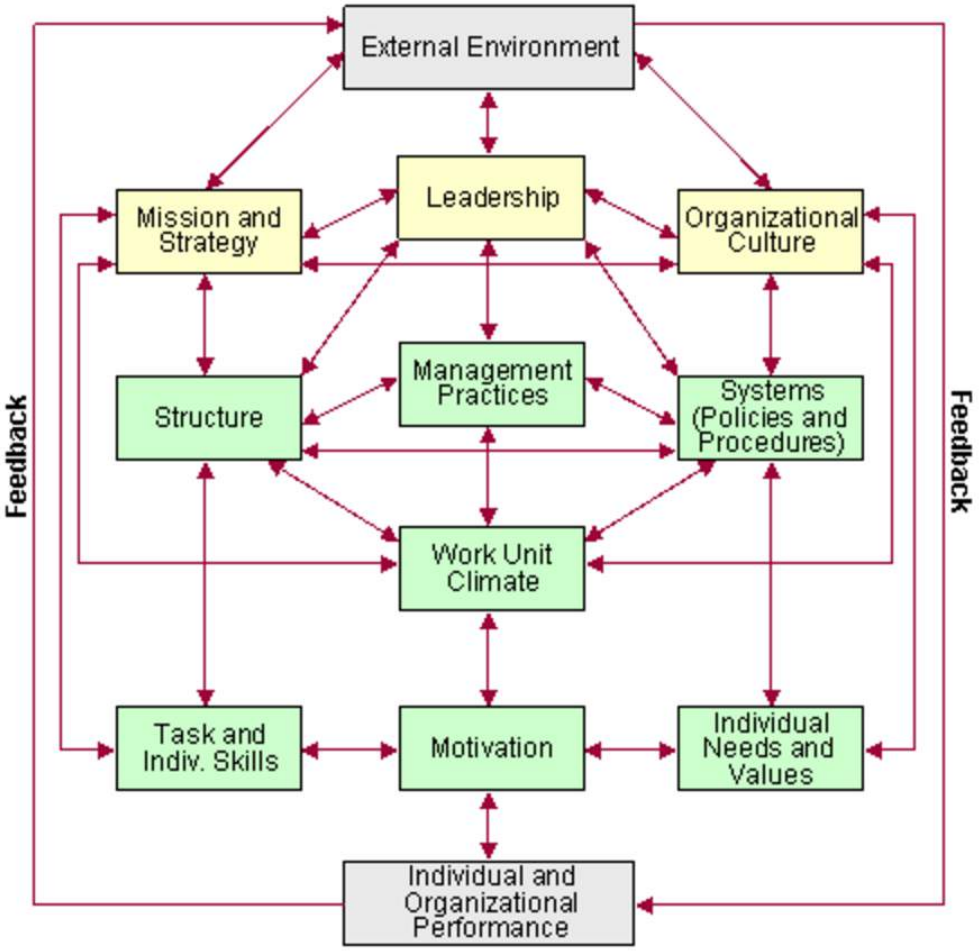

FIGURE 4.1: The Burke-Litwin model of organisational performance and change (*Burke-Litwin, 1992*)

Transformational dynamics deal with the transformational processes that are needed to promote change in the organisational culture (Jones & Brazzel, 2012). Transformational factors are those elements in an organisation that interact with external factors to bring about change. Transformational factors are the culture, the strategy, and mission, and leadership of an organisation (Burke & Litwin 1989). These transformational factors usually require behaviour changes of actors in the organisation. Transformational factors are primarily affected by external environmental factors and effect transactional factors (Burke, 2013). The interactions between transformational and transactional factors interact and impact organisational change (Chawane, Van Vuuren, & Roodt, 2003).

4.3.1 Critique of Burke-Litwin framework in light of CR

The Burke-Litwin model provides a causal model for inquiry into the concept of organisational change and performance. However, the model focuses on a limited number of internal and external factors that bring about change.

In the light of critical realist ontology, this suggests that the model is limited to the empirical domain. Burke-Litwin focus on defined events and observed experiences, which in combination with factors that can be manipulated, bring about change in organisations. However, the Burke-Litwin model does not provide in-depth explanations of the underlying mechanisms which cause the change and improve performance. Furthermore, the model does not consider factors which cannot be observed but may influence change (Theron & Spangenberg, 2013). As a result, the model can help to identify the *"whats"* but not necessarily the *"whys"* and *"hows"* of organisational performance. These factors render the Burke-Litwin model unsuitable for developing explanations of generative mechanisms.

4.4 Time Critical Information Services (TCIS)

The time-critical information services (TCIS) model was developed explicitly for EMS organisations (Schooley & Horan, 2007). TCIS focuses on information and communication technology services that enable the provision of EMS to the public. TCIS is based on the work of Schooley and Horan (2006, 2008) to support the study of time-critical information services as a heuristic that allows for a multidimensional view of end-to-end system performance and information sharing in EMS organisations. Time-critical information services include public services which are characterised by high demand and dependence on the critical and timely delivery of information. Information technology plays an important enabling role in facilitating the delivery of such time-critical information services (Horan et al., 2006).

As illustrated in Figure 4.2, the TCIS model consists of a number of hierarchical analytical dimensions. These analytical levels are particularly relevant to public EMS delivery.

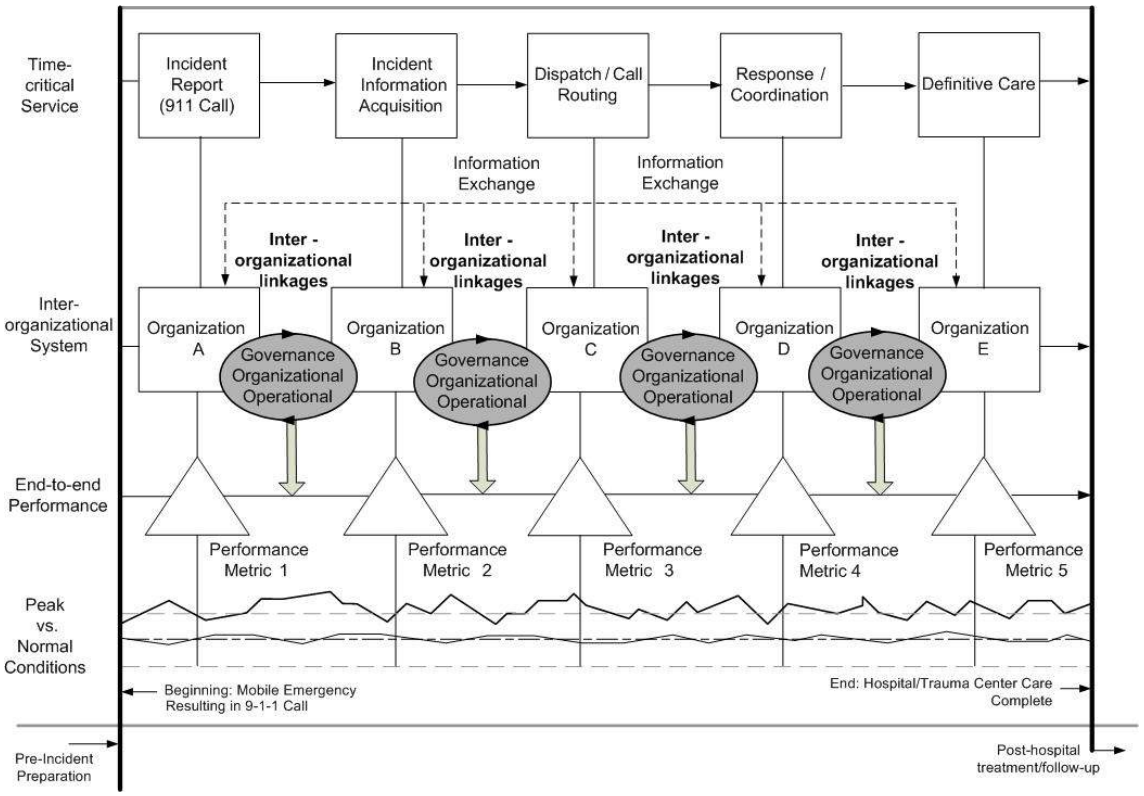

FIGURE 4.2: Time-Critical Information Services (TCIS) framework (*Horan, Marich, & Schooley, 2006*)

1. Layer 1: The criticality time and information service processes
2. Layer 2: Inter-organisational information integration
3. Layer 3: End-to-End performance
4. Layer 4: Context variation (eg. peak versus non-peak)

4.4.1 Layer 1: Time critical services

The first layer of the TCIS framework refers to the criticality of time and information critical processes. According to TCIS, information moves in a time series from one processing unit to the next and may be useful for investigating EMS. A significant challenge for EMS is to maintain the integrity and accuracy of time-critical information (Pan, Pan, & Leidner, 2012; Shan, Wang, Li, & Chen, 2012). Such a challenge is frequently the result of inefficient feedback loops which tend to result in wasted time. Mistakes resulting from incorrect information, poor planning and scheduling can have devastating effects on the health conditions

of patients (Burke, Wang, Wan & Diana, 2002; Mears et al., 2002). This happens, for example, when ambulance paramedics are unable to locate victims because of incorrect location (Siler, 1975). These external dynamics affect the internal workings of EMS organisations which affects performance.

4.4.2 Layer 2: Information integration

The concept of inter-organisational information integration focuses on the conventional inter-organisational relations as well as how they influence and are influenced by information exchanges through organisations (Chen et al., 2007; Van de Walle et al., 2009). Information technologies are often implemented to improve organisational performance, but systemic issues constrain the effectiveness and efficiency of information technologies in driving inter-organisational relationships, integration and information exchange (Solon et al., 2009). From the operational/technical dimension of information sharing, the TCIS framework focuses on the conventional inter-organisational relations. These include business processes, procedures, and technological resources for sharing information and data across organisational boundaries (Dawes, 1996; Sundberg & Sandberg, 2006)

4.4.3 Layer 3: End-to-End performance

Determining the efficiency across various organisations (end-to-end performance) is critical to understanding the process of public emergency service delivery, the quality and timeliness of the delivered service and strategies to enhance the network of EMS organisations to deliver improved services in a timeous and information-critical manner. End-to-end performance is known to be highly dependent on system processes. An essential characteristic of the end-to-end concept is the ability of paramedics to rapidly and effectively respond to incidents. In the context of EMS which involve multiple organisations, performance evaluation from service initiation to response and completion is crucial — this is described as end-to-end performance (Schooley & Horan, 2007). Understanding end-to-end performance across an integrated network of EMS organisations is vital for improving delivery of public emergency services. Performance metrics

include the quality of the service, the speed of service delivery, and how improving the integration of inter-organisational information integration can provide better service to the public.

4.4.4 Layer 4: Context variation

A comprehensive understanding of context variation allows public EMS organisations to manage services better through information technologies and to achieve alternate performance outcomes under different conditions (for example, peak versus non-peak demand of services).

4.4.5 Critique of TCIS framework

Th TCIS framework is an important starting point from an EMS perspective since it allows for a multifaceted view of "end-to-end" EMS performance. However, the framework has limitations within the broader context of CR philosophy. The TCIS framework is based on validated research as well as the assumptions of the intervention designers about how the inter-organisational information systems might lead to performance improvements. However, the TCIS framework ignores issues of agency, pointedly, the critical aspects of human actions, which in this context are mediated by technology. As a result, the TCIS framework is unable to adequately explain how technological artifacts interact with human actors in EMS organisations. This problem stems from TCIS's combination of tasks, information, and tools into a holistic construct while ignoring human agents. For example, it is neither possible to examine competing assumptions, knowledge and techniques which may be rooted in technology artifacts or organisational practices, nor the consequences (intended or unintended consequence) of human actions and cognition in the model (Ash, Berg, & Coiera, 2004; Lipsitz, 2012).

Additionally, it is not possible to observe how the rules and procedures structured into technological artifacts are appropriated and adapted, or disregarded by humans performing tasks (Davis, 1993; Perrow, 1983). Furthermore, information exchange and integration between the multiple EMS organisations may result in critical organisational change processes and substantial unintended consequences. Such unintended consequences are a form of emergent properties.

Consequently, the TCIS framework is incapable of explaining emergent properties.

Nevertheless, emergent properties can be addressed by the theoretical framework of complex adaptive systems (CAS). The properties of a CAS system can be used to "describe a system in a natural and flexible way give it an ability to capture such emergent behaviour of a system" Berry, Kiel, and Elliott (2002). As a result of the limitations discussed above, the TCIS framework is inappropriate for investigating the mechanisms that give rise to performance in EMS organisations. Hence a new mode of thinking is required to reconceptualise organisational performance that goes beyond the limitations of the TCIS framework. In the context of EMS, such a conceptualisation should take into consideration the human agents as well as the complexities associated with both internal and external organisational dynamics.

The next section provides a review and critique of CAS theory and then discusses CAS's relevance in the context of its applicability as well as its limitations as a theoretical lens for the study of IT-enabled organisational performance in EMS organisations.

4.5 Complex adaptive systems (CAS) theory

Complexity science has become a popular and alternative approach to the standard methods of scientific discovery in social sciences (Byrne, 1998). From an IS standpoint, several works have promoted the value of adopting the complex systems perspective in IS research and practice (Courtney, Merali, Paradice, & Wynn, 2008; Merali, 2006). Complexity science is underpinned by a systemic paradigm that considers the world as a set of interconnected entities whose relationships give rise to observable patterns (Jacucci, Hanseth, Lyytinen, Kim, & Kaplan, 2006). This world-view originated from the diverse relationships between multiple non-linear interconnected systems. In contrast to traditional scientific methods that attempt to reduce complexity by investigating individual parts of a system within an isolated ecosystem, complexity science promotes the notion of open systems. Open systems seek to understand the complex relations that provide the system's context (Cilliers & Spurrett, 1999; Holland, 2006).

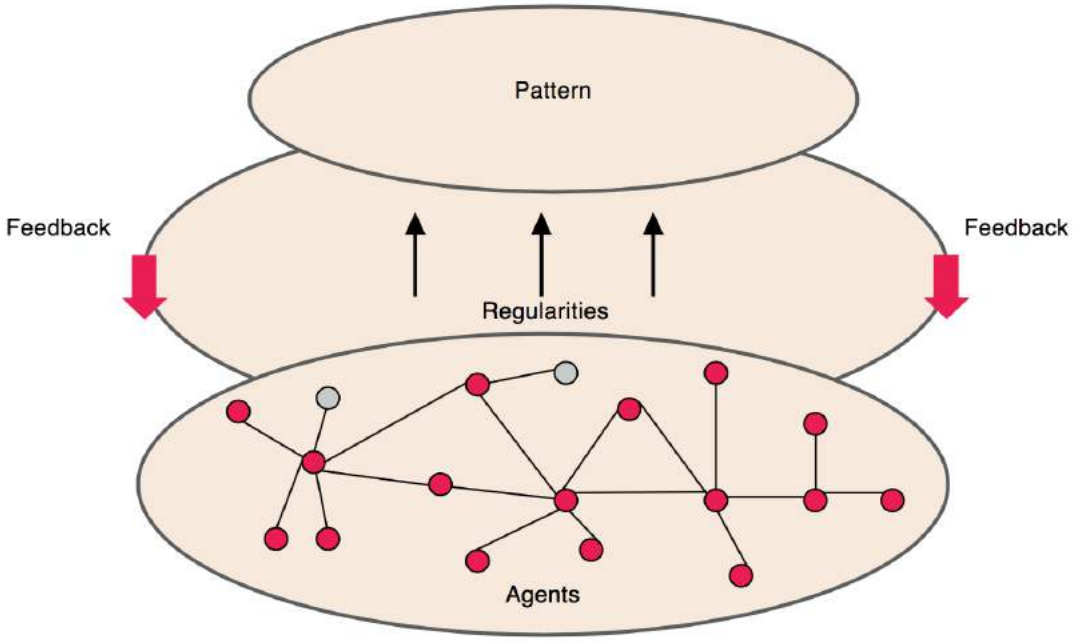

FIGURE 4.3: Complex Adaptive System (Source: Adapted from (*Nan, 2011*))

Complexity arises as a result of the connections between the entities within a system and its environment (Byrne, 1998; Mitleton-Kelly, 2003). The entities consist of smaller self-directed elements.

A fundamental principle of complexity theory is that a collection/group of entities possess "emergent" characteristics, which are in turn, a direct consequence of the relationships and interactions as well as the dynamic properties of these entities' (McMillan, 2004).

Figure 4.3 above illustrates a CAS system. Complex adaptive systems can evolve and adapt over time while displaying high levels of complex behaviours (Byrne, 1998; Cilliers & Spurrett, 1999; Holland, 2006). By definition, complex adaptive systems are systems that consist of numerous distinct components working together as a whole. Letiche (2008, p. 127) defines a complex adaptive system as "an entity composed of many different parts that are interconnected in a way that gives the whole capabilities that the parts don't have on their own". Merali (2004, 2006) define CAS as systems consisting of many interconnected, and interactive parts, which together form a bigger unit, which in turn depends on a specific environment.

Various approaches have been used by researchers to explain the complex adaptive systems theory. For example, Drazin and Sandelands (1992) summarised the core functioning of CAS as three fundamental dimensions of structure; deep structure; elemental structure; and observed structures. Meanwhile, Holland (1995) and others have described the elements and mechanisms of CAS through attributes. These include adaptation, coevolution, nonlinearity, self-organisation.

Recently, the use of CAS theory has gained attention from many IS scholars. CAS has been applied CAS to investigate a wide array of phenomena including IT/IS use (Nan, 2011), inter-organisational information systems (Wainwright & Waring, 2004), an agile software development (Vidgen & Wang, 2009). Concerning IS in healthcare, some of the most popular concepts include adaptation, self-organisation, non-linearity, and emergence (Holland, 1995). These are briefly discussed below.

4.5.1 Adaptation

Adaptation is the capability of a complex system to change its behaviour based on changes in its environment (Holland, 1995; Majchrzak, Rice, Malhotra, King, & Ba, 2000). Scholars argue that healthcare organisations tend to adapt

Their behaviour over time through their interactions with their environments. Likewise, healthcare organisations comprise individual human agents (e.g., doctors, patients, hospitals) that are constantly interacting. This has led the use of complexity theory to study various aspects in healthcare organisations.

4.5.2 Self-organisation

There are many different definitions and perspectives of self-organisation in literature that may be valuable depending on the context. These include Mathematics (Lendaris, 1964), Physics (Ashby, 1991; Von Foerster, 2003), Information systems (Anderson, 1999; De Wolf & Holvoet, 2005; Gershenson & Heylighen, 2003; Haken, 2006; Merali, 2004; Prokopenko, Boschetti, & Ryan, 2009).

The concept of self-organisation in healthcare studies mostly seeks to understand the dynamics governing the processes of inter-connected entities evolving

from simple individual components to complex healthcare systems (Prokopenko et al., 2009).

Dimension	Description	Reference
Adaptation	Adaptation is the capability of a complex system to change its behaviour due to changes in its environment	Holland (1995); Majchrzak et al. (2000); Nan (2011); Paina and Peters (2012)
Nonlinearity	The interactions between components of a system generate new and non-linear patterns. Nonlinear and unpredictable interactions occur at micro and macro levels.	Byrne (1998); Cilliers and Spurrett (1999); Mitleton-Kelly (2003); Nan (2011)
Self-organisation	Dynamics governing the processes of interconnected entities self-organising from simple individual components to a more broader complex system.	Ashby (1991); Holland (2006); Lendaris (1964); Polani, Prokopenko, and Yaeger (2013); Prokopenko et al. (2009); Von Foerster (2003)
Emergence	Individual entities or agents within CASs interact to produce new, emergent behaviours	Curşeu (2006); Holland (2002); Merali (2006); Mitleton-Kelly (2003); Prokopenko et al. (2009)

Table 4.2: Summary of CAS concepts relevant in the context of EMS

4.5.3 Non-linearity

A fundamental property of non-linear systems is that they are open and constantly changing and adapting to conditions (Cilliers & Spurrett, 1999; Curşeu, 2006; Holland, 2002). Although the historical context of the system is important

in understanding its dynamics, the interactions between components of a system generate new and non-linear patterns. Such non-linear and, consequently, unpredictable interactions occur at both micro and macro levels. The micro level consists of human interactions, (healthcare practitioners, patients, nurses, and doctors) while macro levels are interactions at the organisational level (public-private healthcare organisations, police departments, fire departments).

4.5.4 Emergence

A distinctive property in the complexity theory discourse is that complex systems comprise individual components (Paina & Peters, 2012). Consequently, complex systems function through the interactions of several components on multiple levels. These interactions cause new levels to emerge in the system (Holland, 2002; Smith, Brighton, & Kirby, 2003) which then interacts with other systems in its environment. This collective behaviour is often referred to as emergent. Therefore, emergence can be said to be the combined behaviour of components in complex systems that do not exist in their separate entities.

4.5.5 Conceptualisation of IT-use using CAS theory

Given the diverse uses CAS theory, there is a consensus among IS scholars that there is no universal conceptualisation of CAS (Anderson, 1999; Vidgen & Wang, 2009). However, researchers agree on three fundamental properties that constitute the essential elements of a CAS; (1) interconnected agents, (2) interactions, and (3) the environment (Cilliers & Spurrett, 1999; Nan, 2011; Onik, Fielt, & Gable, 2017).

Considering that IT-use in EMS organisations involves a complex use of technology, it is often challenging to determine the cause and effect relationships between IT-usage and performance outcomes. Nan (2011, p.511) argues for the use if the CA framework which *"...allows us to see the contribution of individual differences and technology characteristics to a bottom-up process of IT use"*.

The conceptualisation of IT-use from a CAS perspective proposed by Nan (2011) is adopted and adapted in this study to provide the context of resource constrained EMS organisations. This conceptualisation acts as a guiding framework

for analysing the processes through which individual level IT use activities produce aggregate-level IT-use patterns and outcomes. This is consistent with previous IT-use conceptualisations in the literature (cf. DeSanctis & Poole 1994; Jasperson et al. 2005; Markus & Silver 2008; Orlikowski 1992). In the context of resource constrained EMS organisations, IT-use conceptualisation focuses on the bottom-up process of IT-use and concentrates on the three fundamental elements of CAS — (1) interconnected agents (i.e human agents or IT users, IT features),(2) interactions (interactions between human agents and IT features), and (3) the environment (the contextual structures that exist in the EMS environment).

Figure 4.4, illustrates the agents' interactions with IT features that bring about the emergence of organisational performance outcomes.

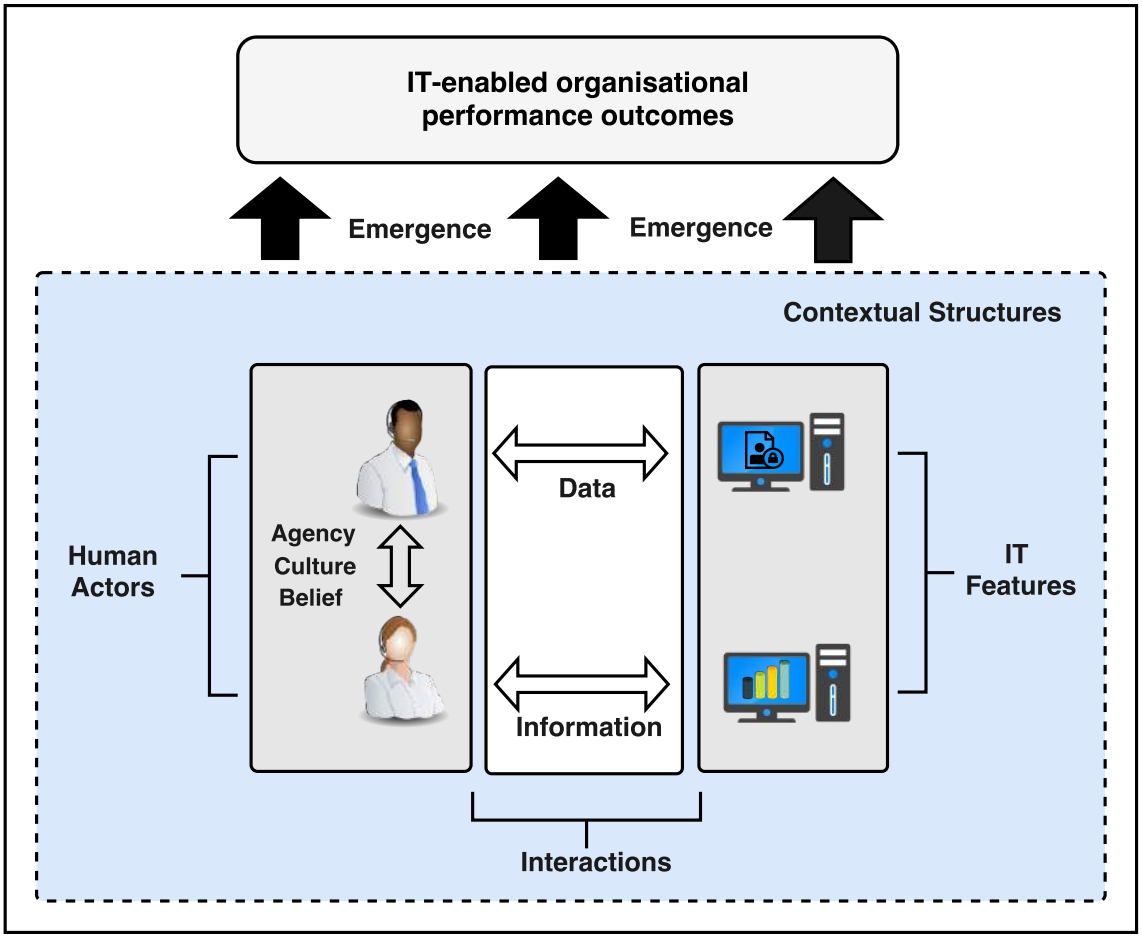

FIGURE 4.4: CAS analytical model of IT use (Adapted from Nan,(2011))

4.5.6 Interconnected agents

Agents represent the basic tenets of CAS (Dooley, 1996). According to CAS, agents characterise people, teams or objects. Agents have intrinsic properties, and their behaviours are controlled by a set of guidelines or rules, which define their interactions with other system agents and with the environment (Nan, 2011; Onik et al., 2017). Two classifications of agents are relevant in this study, human agents and IT features. Following a bottom-up process of IT-use, this study seeks to understand how human agents interact with technology.

4.5.7 Interactions

According to CAS, agents' interactions cause the outcomes to emerge. These interactions characterise the relationships between the interconnected agents with their environment (Onik et al., 2017). In this study, the arrangements formed by the individuals in EMS organisations as well as their different roles represent the structure of the interactions between themselves. This CAS conceptualisation of IT-use provides insight on how IT modifies organisational performance by analysing constitutive agents' use of technology. Table 4.3 illustrates the mapping of the CAS concepts to IT use concepts.

4.5.8 Environment and structures

Open systems, such as EMS organisations, are characterised by multiple elements which interact to produce observed outcomes underpinned by different kinds of mechanisms. An important characteristic of CAS is that, over time, they can adapt and learn to respond to changes in their environment (Holland, 2002, 2006).

The following section provides a rationale for the choice of CAS theory to study IT-enabled organisational performance.

Table 4.3: Mapping IT Use Concepts constructs to CAS constructs. (Source: Nan (2011))

CAS	IT Use	Description
Agent	Human actors	The individual users involved in IT use processes including IT novices and IT experts
	IT features	The building blocks or basic components of a system such as the text editor in an office system
• Attribute	Individual differences	The internal states of human actors such as demographic backgrounds, cognitive styles, and personality traits
	Technology characteristics	The internal states of IT features such as system reliability, flexibility, and richness
• Behavioral rule	Mental activities	The cognition and emotions of human actors
	IT functionalities	The set of functions or capabilities delivered by IT features such as information access
Interaction	User-system interactions	The mutually adaptive behaviors between human actors and IT features
	Interpersonal interactions	The mutually adaptive behaviors between human actors
• Connection	User-system links	The direct uses of IT features
	Interpersonal ties	The relationships between human actors
• Flow	Movement of intangible IT resources	The distribution of knowledge, information, beliefs, and other intangible IT resources among human actors and IT features
Environment	Environment	The social organizational contexts
• Structure	Social and organizational structures	The properties of social organizational contexts such as business strategies, culture, rules, and work requirements

4.5.9 Rationale for choosing CAS theory

The term "complexity" in the context of this study embodies the organisational intricacies associated with the use of IT for the provision of EMS. Two fundamental characteristics qualify IT use in EMS organisations as both complex and adaptive in the context of resource-constrained EMS. First, the overall IT-enabled organisational performance was considered to be *emergent* as opposed to predetermined. The underlying complexity was largely a result of multiple entities and agents (people, processes, technology) interacting to bring about emergence of performance outcomes. Hence, complexity theory was the appropriate theoretical lens for analysing how these interactions between agents, technology and environment gave rise to IT-enabled organisational performance.

Secondly, CAS theory allow the explanation of how individual agents and sociotechnical elements interact, communicate and evolve within a larger ecosystem

of emergency service provision. Furthermore, IT-enabled organisational performance represented dynamism between the IS/IT-use domains and the EMS domain as well as the human agency- interactions. Lastly, the rationale for choosing CAS theory was also motivated by the fact that healthcare organisations — and in particular EMS organisations — have previously been theorized as complex adaptive systems (Begun, Zimmerman, & Dooley, 2003; Tan, Wen, & Awad, 2005). Thus, CAS theory provided an opportunity to analyse how the use of IT shapes organisational performance from a complex adaptive systems perspective. Thus, complex adaptive systems theory was considered highly relevant in ascertaining the underlying IT-use mechanisms and contextual factors that gave rise to organisational performance outcomes for this study.

4.6 Institutional theory

There are several perspectives of institutional theory in IS literature. Organisational scholars highlight the role of institutions (normative and taken-for-granted rules) in the study of organisations, and how institutions can both enable and constrain actors' basic interests, and influence behaviours and actions. Institutional theory describes how widely held beliefs and cognitions are reinforced by the actions of actors and how they affect organisations (Barley & Tolbert, 1997). Formal and informal institutional contexts can constrain or enable the behaviour of firms (Campbell, 2004). Institutional theory strives to provide theoretical and empirical explanations that organisational structures provide superior explanations of different forms of institutionalisations in organisations.

Institutions are defined as the social structures that are based on taken-for-granted, formal or informal rules that enable or constrain social behaviour thereby controlling and shaping it (Bjorck, 2004). Scott (2001, p. 48) defines institutions as social structures that are "characterised by a high degree of resilience". Institutions "gradually acquire the moral and ontological status of taken-for-granted facts which, in turn, shape future interactions and negotiations" (Barley & Tolbert, 1997, p. 94). According to Scott (2001, p.49), these social structures consist of "symbolic elements, social activities, and material resources".

Institutional theory argues that organisational environments are both institutional and technical. This means that organisational environment provide both

information and resources to enable the production of goods and services. As such, organizations are rewarded for creating internal structures that are, according to DiMaggio, Powell, et al. (1991), similar in form and structure with pressures emanating from external environments.

According to Powell and DiMaggio (2012), institutional theory are characterised by three types of institutional pillars — Regulative, Normative and Cultural-Cognitive. These pillars operate through three important isomorphic forces. These are coercive, normative and mimetic isomorphic forces (DiMaggio et al., 1991; Tolbert & Zucker, 1999). Regulative pillar operates through coercive isomorphism. These are indicators for rules, laws and sanctions. Normative operates through normative isomorphism (Scott & Meyer, 1994). The indicators for these are accreditations and certifications. Finally, cultural-cognitive operates through mimetic isomorphism. Its indicators are prevalence. Overall, the three institutional pillars and its isomorphic forces collectively influence and or constrain organizational environments (DiMaggio et al., 1991; Powell & DiMaggio, 2012; Scott & Meyer, 1994).

For organisations to be efficient, some rules ought to be enforced in organisations. These rules should include methods of applications to monitor how individuals adhere to the rules, and monitoring mechanisms with penalisation methods when the rules are broken (Bjorck, 2004). The rules in an organisational context enable and constrain organisations to behave in a particular manner (Effah & Nuhu, 2017).

Research on institutional theory highlights the fact that actors and institutions are 'mutually-generative' (Scott, 2011). In other words, institutions are produced, shaped and influenced by the actions of actors. Simultaneously, the institutional environment plays an important role in shaping the identities and interests of actors. Therefore, institutional theory can be used as a lens to explore how individual actors or collections of actors interact in a particular institutional environment.

Furthermore, in the domain of information systems, the literature shows that the use of IT in organisations has become widely institutionalised. Pishdad, Haider, and Koronios (2012) argue that "Technology works as the binding factor that shapes organisations and gives them their existing form and legitimacy

by integrating together these sub-institutions...". Avgerou (2000, p. 237) identifies five characteristics that qualify IT as institutions in organisations. Table 4.4 illustrates these characteristics with brief explanations.

TABLE 4.4: Institutionalisation of IT in organisations (Adapted from Avgerou (2000))

Characteristic	Explanation of Institutionalization of IT
De-facto standard for modern, "post-industrial" society	IT institutionalized as being the established view on the value of technology and knowledge as the axial principles for contemporary, ``post-industrial'' society (Bell, 1973);
A network of industries	IT institutionalized as "a network of industry including hardware manufacturers, telecommunication services providers, software producers, consultants and units internal to "user" organizations which are creating, laying, maintaining, and further expanding a complex world-wide network of material resources and knowledge for technical information processing"
Professional know-how	IT institutionalized as set of professional expertise for the development and use of IT applications;
Sets of regulations for IT development and use	IT institutionalized as sets of regulations for IT development and use, such as codes of ethical practice, copyright legislation, data protection acts, or freedom of information decrees;
Provides rules for defining Standards of Technology practice	IT institutionalized a part of the professional bodies, such as IEEE, ACM to propagate "standards of technology and practice".

Rationale for choosing institutional theory

Institutional theory was used as a theoretical lens to address how institutional structures in the EMS environment affect organisational performance. The institutional theory perspective considers agents as part of a complex inter-institutional system. Thornton (2002, p. 82) notes that while institutions may enable or constrain organisational actions, institutions are inherently "embedded in higher-order institutional logic". As part of the broader system, the agents are confined

by institutional guidelines, which operate on multiple levels of analysis. These guidelines influence the agent's behaviour in the system using codes of conduct, work practices, and organising. According to Scott, (1995, p.60), institutional theory affords the frameworks and rationalisation principles to make claims. As a theoretical lens, institutional theory allowed deeper insight into the contextual structures that exist in the EMS environment. Guarino et al., (2012, pp. 536-538) argue that "... technical artefacts, like tools and machines, determine what can be done, amplifying and constraining opportunities for action; social artefacts, like norms and institutions, determine what should be done, governing obligations, goals, priorities, and institutional powers." The rationale for an institutional approach was motivated by the fact that institutional theory offers a firm theoretical basis for observing the structures that enable and constrain social behaviour (Bjorck, 2004; Scott, 2013).

In addition, the institutional theory perspective allowed exploration of the relationship between structure and agency of actors as well as the social structures that enable or constrain them in ways that have better explanatory power. Unlike structuration theory, which conflates structure and agency and is incommensurable with the fundamental assumptions of critical realism (Delbridge & Edwards, 2013; Goodrick & Reay, 2011; Mutch, 2006), institutional theory overcomes such limitations by separating structure from agency to address the issue of embedded agency. The separation of structure and agency makes it possible to develop explanations of the "dynamic interplay" between structure and agency (Emirbayer & Mische, 1998, p. 963).

4.7 Integration of multiple theoretical perspectives

Critical realist research studies that generate explanations use multiple theoretical lenses to observe phenomena from various perspectives (Dobson, 1999; Mingers, 2001). In this study, two theories were used; CAS theory and institutional theory. These theories were considered complementary and jointly integrate such that CAS theory was used to analyse how agents interact with themselves and with technology. Institutional theory was used as a lens to deeply analyse and understand the institutional structures embedded in the

EMS environment as well as how these structures influence organisational performance outcomes(Bhakoo & Choi, 2013; Christiaanse & Huigen, 1997; DeSanctis & Poole, 1994). Furthermore, institutional theory has been used to generate substantial explanations of the significance of environments concerning the adaptive nature of organisations.

Explanations of the causal mechanisms and structures that give rise to performance outcomes in EMS organisations must begin with ontological descriptions of what organisations are and how they are formed. Here, the critical realist notion of *'relational emergence'* becomes useful. Elder-Vass (2010) was the first to apply the notion of *relational emergence* to causal mechanisms of entities. Elder-Vass (2010) defines an entity as "a persistent whole formed of a set of parts that are structured by the interactions between these parts" (Elder-Vass 2010, p.17, emphasis in the original). In other words, 'relations' are the processes through which the parts of an entity causally interact to produce an intended effect.

Relational emergence in the context of this study is understood as the relations brought about by the interactions between human agents, and between humans and technology from which IT-enabled EMS organisational performance emerges. According to Elder-Vass (2010) relations "... have causal powers because they are articulated, combined, or configured to form particular wholes". Simultaneously, 'emergence' in relational emergence is how an entity comes into existence, as well as the "relation amongst the parts of an entity that gives that entity as a whole the ability to have a particular ... causal impact" (Elder-Vass 2010, p.23). Hence, the concept of relational emergence fits in well with the definitions of complex adaptive systems (Cilliers & Spurrett, 1999; Merali, 2006). Figure 4.5 illustrates how the emergence of IT-enabled organisational performance is a consequence of the relations and interactions between agents, technology, and resources.

Considered in isolation, the theories would be insufficient to explain the generative mechanisms in the study. Due to the complexity of the phenomenon, the IT-enabled organisational performance mechanisms require more than a single theory to be explained. In this study, the need for the use at least two theoretical lenses to observe the phenomenon, from different positions over time (Bygstad et al., 2016) is therefore necessary. Hence the choice of the chosen theories, CAS, and Institutional theory. Figure 4.5 illustrates the integration between CAS theory and institutional theory. The use of multiple theoretical lenses in this study

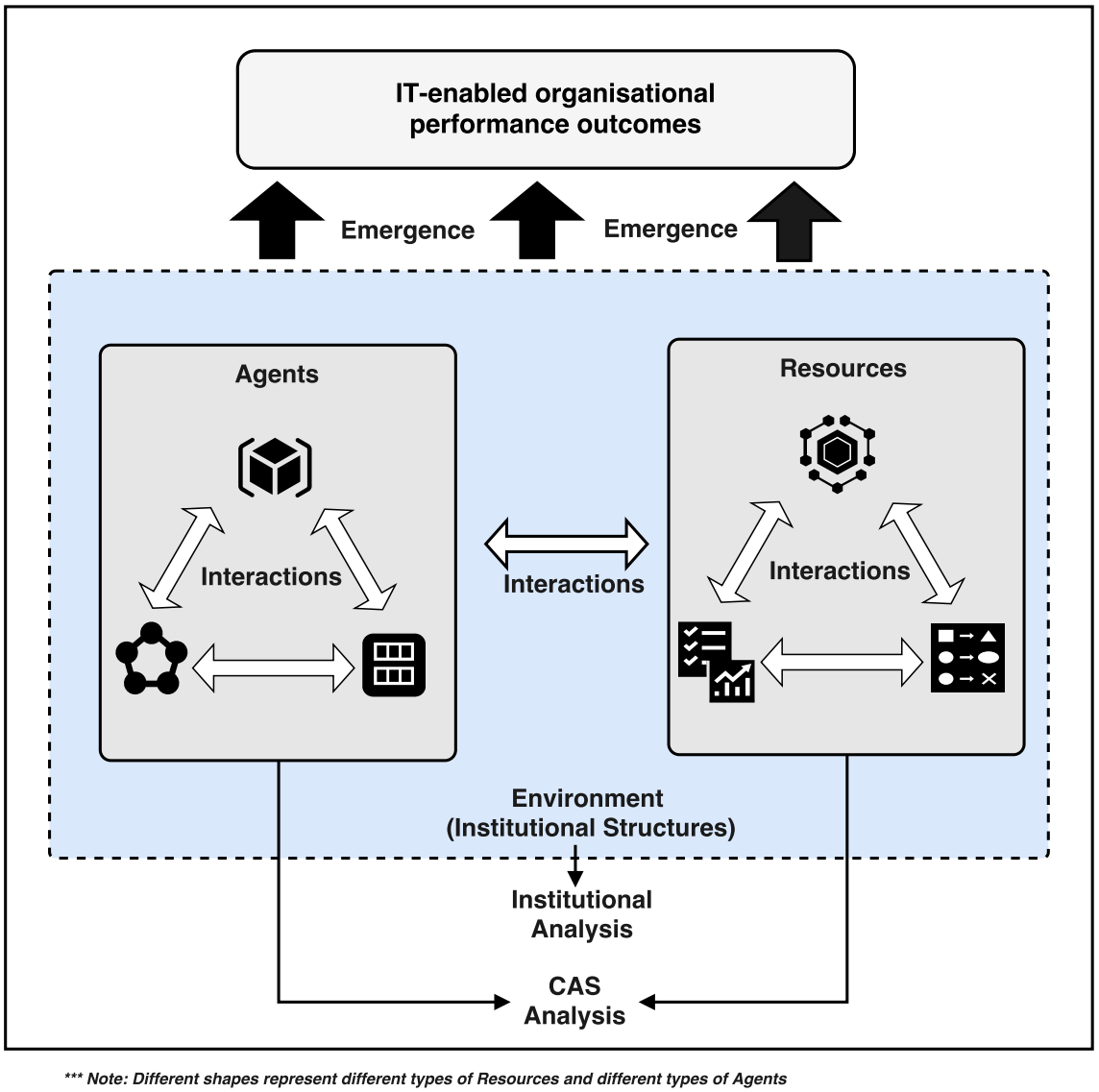

FIGURE 4.5: Two different levels of analyses

is useful because of the multiple levels of analysis that are required. According to Nan (2011) agents and resources can be conceptualised as (a) technology, (b) individual (humans) and team/groups and (c) resources within organisations. Moreover, CAS allows for conceptualising the interactions between these three different types of agents. On the other hand, institutional theory allows analysis of how these agents are affected and influenced by the EMS institutional environment.

provided theoretically resilient sources for investigating the mechanisms of IT-enabled

4.8 Chapter summary

In this chapter, four extant theories were reviewed, and two complementary theories were chosen as the most appropriate to study the phenomenon. The immanent critique (Bhaskar, 2008) of the extant theories allowed to formulate a sound justification for the selection of the CAS theory and institutional theory as the two appropriate theoretical lenses that have the explanatory power to shed light on the research question.

The CAS conceptualisation of IT-use was considered critical to the explanations of generative performance mechanisms in EMS organisations. As such, IT-use in EMS organisations was conceptualised from a CAS theory perspective, while institutional theory was chosen as the appropriate lens to explore the structures in the EMS environment. The conceptualisations were grounded in existing literature. Therefore, concepts try to be as abstract as possible, without being impractical at the same time. The two theories were integrated to allow for investigating the mechanisms that give rise to IT-enabled organisational performance outcomes in the context of resource constrained EMS organisations. The chapter that follows discusses the research design and methods.

Chapter 5

Research Design and Methods

5.1 Introduction

This chapter presents the research design and methodological approach undertaken in this study. The goal of this study is to develop explanations of the generative mechanisms that give rise to IT-enabled EMS organisational performance outcomes. As such, the critical realist methodological assumptions were applied throughout this study, and this chapter describes how the CR methodological and CR case design considerations were followed.

The chapter is structured as follows: Section 5.2 outlines the critical research design assumptions followed in this study. Section 5.3 provides an in-depth description of the how the research design choices were followed in the case study design. In addition, sampling is discussed in this section. Section 5.4 describes the type of data and processes of data collection that was followed and applied. Section 5.7 provides an in-depth discussion of the framework for data analysis. Section 5.8 discusses the quality criteria to assess and evaluate the quality, validity, and rigour of this study. The penultimate section 5.9 discusses the ethical considerations, and the chapter concludes with a review and summary of the entire chapter in section 5.10.

5.2 Research design

While most research approaches in IS are useful, CR research strategy tends to be distinct from positivist and interpretivist paradigms. As discussed earlier, the primary goal of CR research is to identify and develop explanations for the underlying generative mechanisms that produce observed outcomes (Archer et al., 2013; Dobson et al., 2007).

As a method, CR scholars consider case studies to be suitable method for conducting research (Easton, 2010; Wynn & Williams, 2012). Effective design identifies the contextual conditions in which these underlying mechanisms operate (Ryan et al., 2012). A case study was considered appropriate for this study as it provided an opportunity to focus on the causal mechanisms, contextual factors as well as their various interactions, in depth. From these factors, explanations for the mechanisms that gave rise to observed performance outcomes were developed. The following section discusses the merit of the case study method for a CR investigation and explains how it was applied in this research. The process is illustrated in Figure 5.1 below.

5.3 Case study design

Case studies are particularly appropriate when developing theoretical explanations (Orlikowski & Baroudi, 1991; Yin, 2003). An advantage of case study research is the ability to provide answers to *'why'* questions (Easton, 2010). In addition, case study methods involve the use of multiple sources and techniques of the data collection and analysis (Benbasat, Goldstein, & Mead, 1987). As an explanatory study, the dynamics of why and how the mechanisms interactions give rise to organisational performance outcomes need to be explained. Consequently, a deeper understanding of the phenomenon is necessary. Yin (2003) argues that the case study approach provides opportunity for a deeper understanding of a single phenomenon through comprehensive and detailed data collection procedures.

Eisenhardt (1989b, p. 534) defines case study methodology as a research strategy, whose focus is on understanding the dynamics that exist within a specific

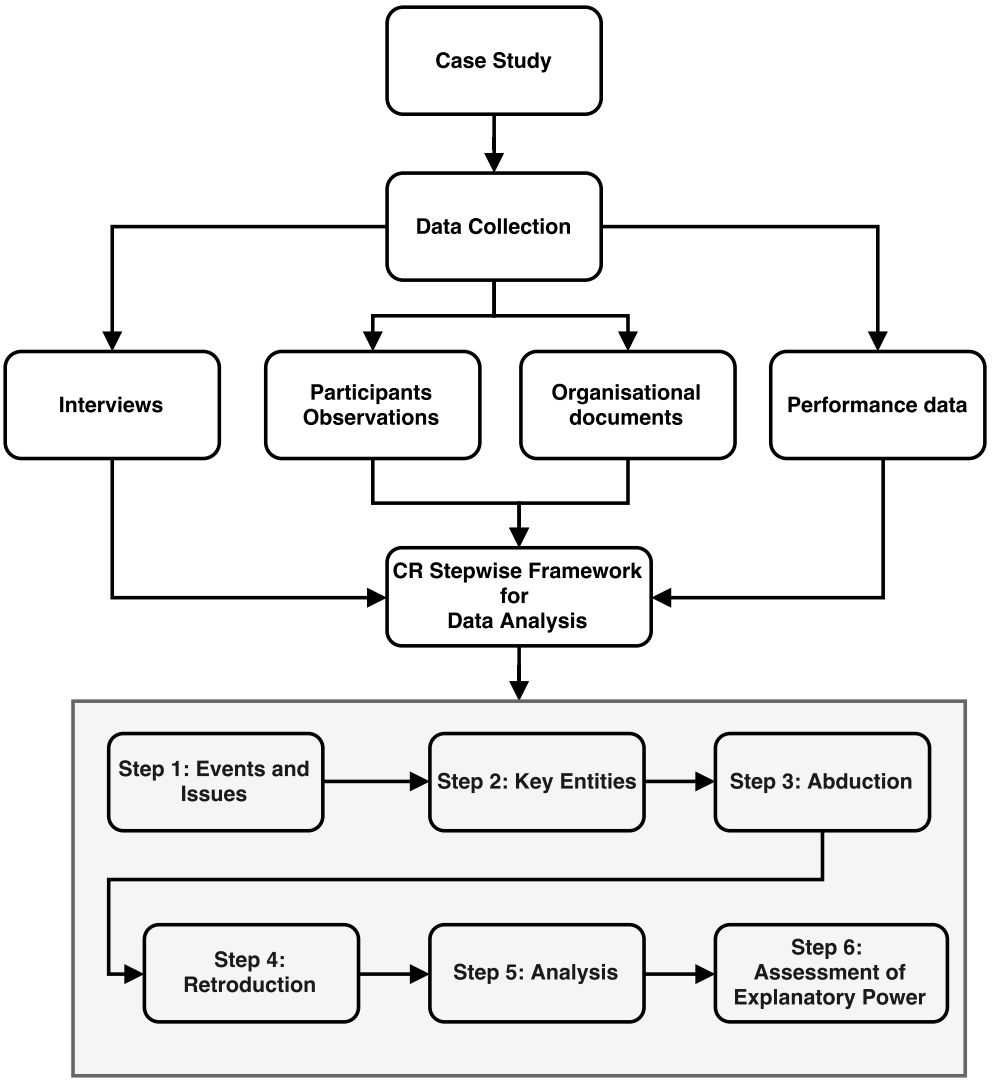

FIGURE 5.1: Research design

setting. The case study involves an exhaustive — often longitudinal — investigation of a particular case, event, or incidence (Yin, 2003). The primary idea is to generate explanations of why and how particular events or situations occurred. In this study, what mechanisms cause different performance outcomes were the primary interest. According to Yin (2003), a case study can comprise either a single study or multiple studies. Depending on the type of research, the researcher can choose which is the most appropriate. For this study, a single case study was more appropriate because it allowed focussing on the phenomenon in depth, and because the researcher was familiar with the organisation in which

the study was situated. Furthermore, the use of multiple methods of data collection (interviews, participant observations and documents) provided an understanding of multiple dimensions of the phenomenon while overcoming limitations associated with a singular data collection method.

Critical realism suggests that causal activities are a series of connected events in which an entity's latent powers are triggered in a logical order (Astbury & Leeuw, 2010; Collier, 1994). Essentially, causal activities are made up of several causal mechanisms which interact to generate the observed events. Hence, abduction and retroduction, rather than deduction or induction are the appropriate logics of discovery (Danermark et al., 2001; Wynn & Williams, 2012). In the context of EMS organisations, individual actors and groups possess latent powers or potentials which, when they interact with each other (or the environment), produce a series of highly connected social processes. These, in turn, shape organisational performance outcomes. It follows then that EMS organisations have emergent properties as a result of the agential interactions involving causal mechanisms. However, these causal mechanisms and emergent properties may not be directly observable but can be indirectly apprehended through a meticulous and iterative reconstruction guided by an explanatory framework.

5.4 Data Collection

5.4.1 Method of data collection

Four forms of data were collected at different levels and functional areas of the organisation: 1) Interviews 2) Participant observation, 3) Organisational documents (e.g., policies, procedures, rules, reports) and 4) Performance data (e.g., performance reports and system data logs).

Qualitative content analysis was used to analyse interview data, participant observations field notes, and organisational documents. This will be discussed in later sections. The subsequent section will discuss how the data were gathered.

5.4.2 Interviews

The primary method of data collection was using interviews. It is well established that interviews are the most common tool used in qualitative studies (Conboy, Fitzgerald, & Mathiassen, 2012; Keutel, Michalik, & Richter, 2014). The rationale behind using interviews was to gain insights into the perceptions, opinions, and issues that exist that are not directly observable to the human eye (Archer, 1995; Mingers, 2001).

The interview technique was appropriate as hidden mechanisms and the potential enabling, or disabling structures were discerned from the opinions of the participants (Creswell & Clark, 2007). Participant opinions were essential as the research aimed to explore underlying constructs of the complex system, (e.g., emergence, non-linearity) to identify and discern the complex social structures at play in the case. Semi-structured interviews were conducted with the EMS organisation staff guided by themes derived from the CAS theoretical framework and institutional theory. A set of predetermined and open-ended questions were used to guide the interviews (Myers & Newman, 2007). This allowed flexibility for reacting to responses and adaptation of follow up questions (DiCicco-Bloom & Crabtree, 2006). The researcher asked for clarification to get a better understanding of the phenomenon where necessary. Six senior managers, five supervisors, two quality analysts, one liaison officers, one trainer, five call takers and five dispatchers were interviewed. Due to the nature of paramedic work, it was challenging to find paramedics who were willing to provide interviews as they were always busy. However, recorded interviews with two paramedics conducted by WCEMS were used as a secondary data source. Table 5.1 illustrates the number of interviews conducted with participants.

A systematic approach with constructs of both CAS and institutional theory was required to investigate the mechanisms that can lead to observed performance outcomes to obtain valid responses from interviewees. An interview guide was formulated from the literature on complex adaptive systems theory, institutional theory, and critical realism. The researcher meticulously applied CAS and institutional theory in an EMS context to 'interpret' and operationalise the concepts into understandable elements for interview respondents (Refer to Appendix B for the interview guide).

Table 5.1: Interview data sources

Interview Data Sources		
Interviews: Managers		
Role	**Responsibilities**	**Duration**
Center manager	Responsible for running operations of the center	1hr 10 min
Assistant Center manager	Assisting with the operations of the center	1hr 5 min
Communications manager	In Charge of communications	45 min
ICT manager	In charge of ICT Infrastructure	50 min
Training Manager	In charge of user training	1hr
Project manager	Managing ICT projects	35 minutes
Interviews: Supervisors		
Supervisor 1 to Supervisor 5	Shift allocation, performance monitoring	Approx. 1 hr each
Interviews: Quality Assurance (QA) & Quality Improvements (QI)		
Quality Assurance	Monitoring and evaluating quality of service and performance	1hr 5 min
Quality Improvement	Monitoring devising recommendations for performance improvements	1hr 20 min
Interviews: Stakeholders liaison officer		
Liaison officer	Liaising with different stakeholders	Approx. 45 minutes
Interviews: Dispatchers		
Dispatcher 1 to Dispatcher 5	Ambulance dispatching	Approx. 45 min each
Interviews: Call-Takers		
Call-taker 1 to Call-taker 5	Emergency call taking	Approx. 45 min each

5.4.3 Participant observations

The observation data collection techniques require researchers to observe behavioural occurrences, events and processes that manifest within a research setting (Creswell & Clark, 2007; Creswell, Clark, Gutmann, & Hanson, 2003). Factual data is gathered objectively through either participative or non-participative observation (Creswell & Clark, 2007).

Participant observation is a data collection technique/tool used in qualitative research which involves the collection of data about individuals, or groups of

people, cultures, and processes (DeWalt & DeWalt, 2010). Participant observation is mainly associated with exploratory and explanatory research objectives which defined by "why" questions, causal explanations, uncovering the cognitive elements, rules, and norms that underlie the observable behaviours. Schmuck (2006) argues that participant observation allows the researcher to look for ways in which humans in organisations express their feelings without active verbal communication, to establish how people interact with each other and to look out for the length of time people spend performing various activities. Participant observation is relevant in this context because it allowed the researcher to document and to gain direct experience and to gain an understanding of the context in delivering public EMS. Table 5.2 illustrates the different participant observations data sources from the case.

Table 5.2: Participant observations data sources

Observation Data Type	Description
Field Notes	The notes taken of observations about what the researcher saw, heard, or felt during the observation period with the different participants in the case.
Reflections	Written reflections of the transcribed interviews
Informal conversations and informal interviews	Notes of the different actual informal conversations with the different participants.
Process flows	Visual or verbal recording of common business processes in the case — e.g. flow charts, drawings, stepwise diagram.

The type of data collected is generally referred to as field notes. These are objective, neutral, non-judgemental and comprehensive descriptions of behaviours or events being observed (Marshall & Rossman, 2006, p. 139). Field notes which described the complex actions and interactions between human actors and their interaction with the IT artefact were collected throughout the case study. Figure 5.2 illustrates an example of field notes from the case.

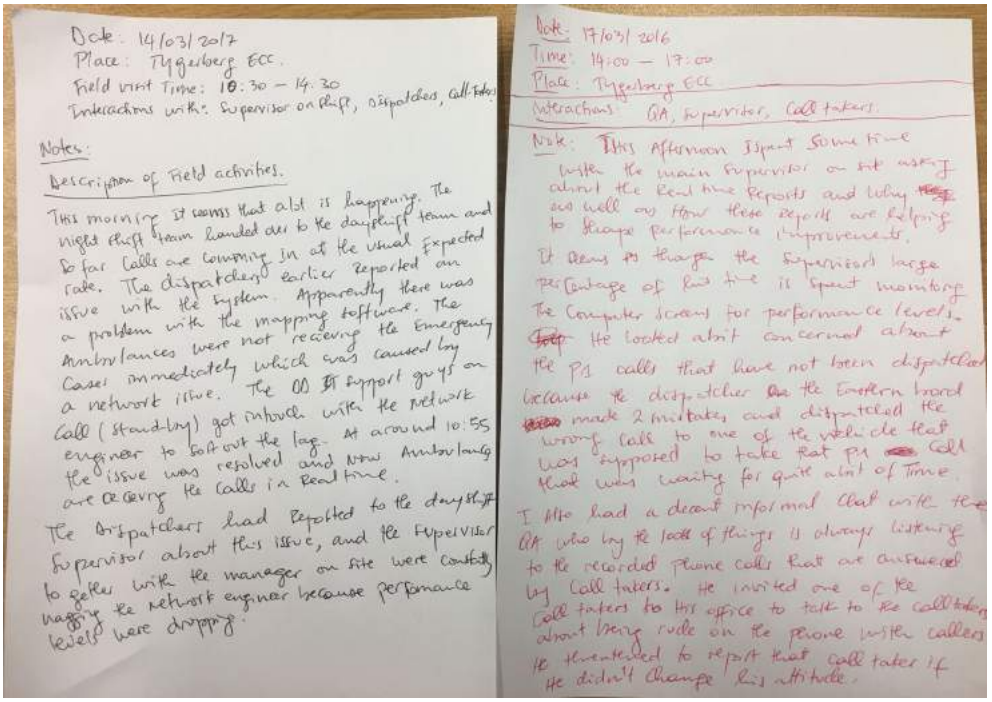

FIGURE 5.2: Example of field notes from participant observations from the case

Observations related to humans actors in their workspace, their interactions with other actors and their complex interactions with information technology were documented. Figure 5.4 and 5.3 provides an illustration of the seating arrangements of the call-takers and emergency service dispatchers at WCEMS.

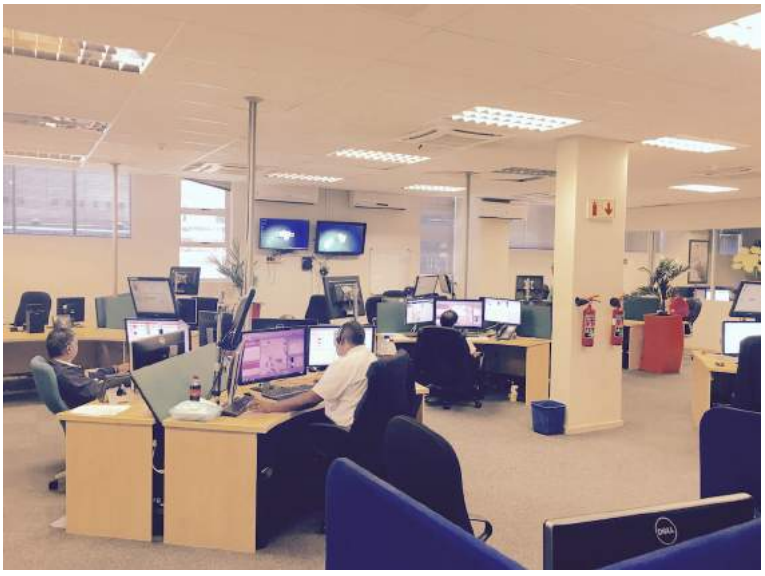

FIGURE 5.3: Sitting arrangement of emergency Dispatchers at WCEMS

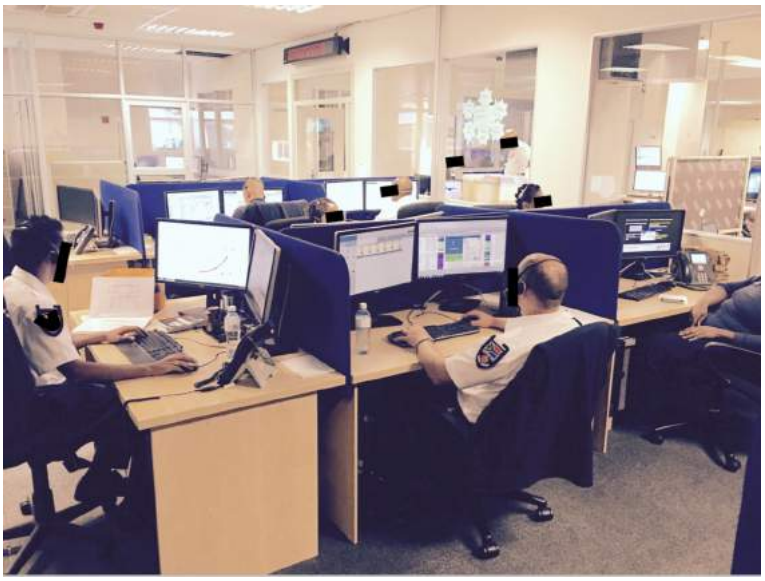

FIGURE 5.4: Sitting arrangement of emergency Call-takers at WCEMS

5.4.4 Documents and data sources

Documents such as policies, procedures, rules, reports, were collected and integrated with the interview data to add any subtle difference in meaning, opinion or attitude that may exist in the sources. The documentary sources were triangulated with the gathered data and added as new information where they were found to be useful.

TABLE 5.3: Documents data sources

Author	Document	Description
South African Government	The South African National Health Act, 2003	The national Act regulating the health sector and the provision of healthcare services in South Africa
Western Cape Government Department Of Health	Western Cape Ambulance Services Regulations, 2012	Regulation governing the registration of ambulance services in the Western Cape province, the management of these services,
Western Cape Government Department Of Health	Western Cape Ambulance Services Act, 2010	Regulation governing the Western Cape Ambulances services
Western Cape Government Department Of Health	Western Cape Government Department Of Health: Annual Performance Plan 2017-2018	Annual performance repot describing all the Western Cape Government health activities, targets and goals with respect to service delivery for 2017-2018 financial year.
Western Cape Government Department Of Health	Western Cape Government Department Of Health: Annual Performance Plan 2016-2017	Annual performance repot describing all the Western Cape Government health activities, targets and goals with respect to service delivery for 2016-2017 financial year.
Western Cape Government Department Of Health	The Western Cape Department Of Health Annual Performance Report: 2011-2012	Annual performance repot describing all the Western Cape Government health activities, targets and goals with respect to service delivery for 2011-2012 financial year.
Western Cape Government Department Of Health	Department Of Health Annual Report 2013-14	Annual performance repot describing all the Western Cape Government health activities, targets and goals with respect to service delivery for 2013-2014 financial year.
Western Cape Government Department Of Health	The Western Cape Department Of Health Annual Performance Report: 2015-2016	Annual performance repot describing all the Western Cape Government health activities, targets and goals with respect to service delivery for 2015-2016 financial year.
Western Cape Government Department Of Health	Department Of Health: Strategic Plan 2015 - 2019	Strategic document describing the vision of the Western Cape health for the years 2015-2019
Western Cape Government Department Of Health	Department Of Health: Infographic Strategic Plan 2015 - 2019	An inforgraphic depicting all the official healthcare statistics in the Western Cape Province
Western Cape Government Department Of Health	The 2030 Future Of Healthcare In The Western Cape	Strategic document depicting the vision of the Western Cape in terms of future innovations and service provision targets to be achieved by 2030
Western Cape Government and Western Cape EMS	A101 Stakeholders and Organisation Structure B201 Features - Priority Matrix v1.1 B202 Non-Functional Requirements v1.1 B202 Non-Functional Requirements - Priority List v1.1 B301 Information Requirements B401 Solution Architecture v1.1	Strategic Information Systems documents describing the functional and non-requirements of Western Cape EMS information technology services.
Western Cape EMS	Evolving-Ems-In-Africa-A-Western-Cape-Experience-2012	Report depicting progress of EMS in the Western Cape Province.

5.4.5 Performance data

Moving through the three different domains (the real, actual and empirical) in search of the underlying structures and mechanisms requires a research approach that is flexible to accommodate such a complex endeavour. System data logs were interrogated in an attempt to get a historical perspective of performance fluctuations recorded by the Computer Aided Dispatching (CAD) system IT artefact. This allowed for a richer perspective when triangulating information through cross-referencing events that might have caused performance improvements or deterioration. Table 5.4 below, provides a summary of how the data collection phases and analyses are mapped to the analytical concentration and the relevant research questions.

Data Collection Instruments	Data Analysis	Analytic concentration	Relevant Research Question
Interviews	Empirical events and experiences Discourses of practices in an EMS organisation and how it is linked to end-to end-performance. Structures of IT-enabled EMS response services.	Uncover power relations. Intra and inter-organisational cultural and subcultural similarities as well as differences. Uncover structural configurations that give rise to causal mechanisms	Research Questions: 1, 2 & 3
Participant Observation	Field notes from various participants observations within the research site which describe the complex actions and interactions between human actors and IT	Elimination of unnecessary, redundant structures and mechanisms that do not contribute to any causal explanations.	Research Questions: 1, 2 & 3
Organisational documents	'Actual' and 'Real" organisational and operational experiences rooted in organisational structures.	1) Power dimensions. 2) Rules and regulations. 3) Structures rooted in business processes	Research Questions: 1, 2 & 3
Performance data	1) IT systems data logs and reports. 2) Communication and Information flows between integrated systems	Historical perspective of performance fluctuations in order to triangulate information through cross referencing events that might have caused performance improvements or deterioration.	Research Questions: 1, 2 & 3

TABLE 5.4: Data types and analytical concentration mapped to relevant research questions

5.5 Sampling

Qualitative purposeful sampling methods were used for this research study (Marshall, 1996; Sandelowski, 1995). Purposive sampling relies on the researcher's judgement for choosing the units of analyses (e.g., people, cases/organisations, events, pieces of data) to be investigated. Generally, the sample investigated is small compared to probability sampling techniques. With purposive sampling, the researcher dynamically chooses the most useful and information-rich cases relevant to the research investigation. According to Merriam (2009), the goal of purposive qualitative sampling technique is to gain insight and understanding as well as discovering in order to provide concrete explanations.

Purposeful qualitative sampling methods can be grouped into two categories: 1) theory driven and 2) data-driven methods. The objective behind both methods is to warrant cases with influential properties that are relevant to the research phenomenon to be included in the sample (Schreier, 2012). The main distinction between the theory and data driven methods lies in the researcher's prior knowledge of phenomenon before conducting the investigation. Schreier (2012) argues that a theory driven sampling method should be chosen when the researcher is able to draw from existing theories or previous research studies and already has some basic knowledge of the characteristics of case that would make it an information-rich one.

For this study, purposive theory driven sampling offered an effective and efficient method of sampling that embodied the phenomenon of interest in its highest variety (Schreier, 2012). This sampling technique was used to develop richer explanations and to capture the complexity of the research phenomenon (Kuzel, 1992).

Sample size

There were in total 25 senior managers, 8 supervisors, more than 35 call-takers and 30 dispatchers. Given that purposive sampling was used, participants were selected from each category of possible respondents for the interviews. Because of the nature of the work, it was not practical to interview more than 5 participants per day. Based on the availability of staff and 'busyness' of the control centre, the centre managers provided a list of staff members which the researcher

was allowed to interview on each day. It was difficult to get access to the medical paramedics because of the nature and schedule of their work. The only time they were available is during their lunch times and they preferred to take that precious time off to rest.

5.6 Developing the coding scheme

The study employed a combination of concepts and data-driven coding techniques. Initially, a deductive coding technique was used (Hsieh & Shannon, 2005) which was drawn from CAS and institutional theory supported by the literature. Qualitative Content Analysis (QCA) was used to analyse the transcribed interviews with respect to their content. QCA is a standard method for systematically analysing text (Blaikie, 2009; Elo & Kyngäs, 2008; Hsieh & Shannon, 2005; Schreier, 2012). With QCA, the focus is placed on what has been said rather than how often it has been said (Elo & Kyngäs, 2008; Schreier, 2012). Figure 5.5 illustrates the processes of QCA. Furthermore, QCA typically involves creating the coding structure and the coding of the text. This process prevents the researcher from becoming overwhelmed by the data (Schreier, 2012).

ATLAS.Ti software for qualitative analysis was used to organise the categories and for coding the material. The interview transcripts were systematically organised into (i) main categories and (ii) subcategories. Typically, the "main categories" are the central focus of the investigation. The subsequent step involves matching the subcategories to the main categories by classifying/grouping similar statements (from the content of the interview transcripts) to a specific topic into subcategories. There are three ways this is achieved: firstly, data-driven, i.e., inductively from the data; secondly, concept-driven, i.e., deduce from existing literature or theory; and thirdly a combination of the two approaches (Schreier, 2012).

Following the content analysis techniques, a code dictionary was developed by identifying phrases and keywords that acted as pointers for the categories. This resulted in a coding framework that was applied throughout the data analysis, underpinned by the two theories and literature, with additional codes developed from fundamental CR concepts. The first technique was through the use of a traditional search of text samples. Words and acronyms frequently used by

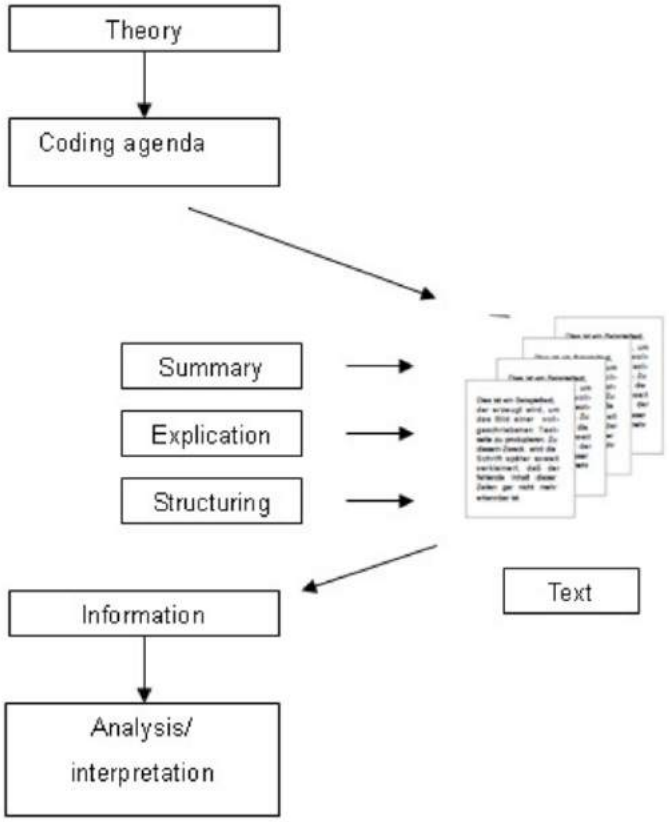

FIGURE 5.5: Steps in QCA analysis (Source: Mayring (2014))

the researcher to refer to specific categories were included as pointers to those categories. Next, a keyword-in-context technique was used to look up text samples.

ATLAS.ti allows the interrogation of the textual proximity of a word or a category that has been partially determined. In so doing, it allowed the identification of additional keywords and phrases that were connected to the concept categories identified in the previous step. Synonyms were taken into consideration to look for words that had the same meaning in each category. This allowed the researcher to develop robust and reliable search texts for the high-level categories. The combination of these techniques helped eliminate any potential ambiguities in the meaning of complex words and phrases. During this coding process, the initial 25 preliminary codes were expanded to 105 codes. During the second coding cycle, the 105 codes were reduced as the codes were refined, combined and enhanced with new codes that emerged from the data until all the transcripts were coded. Finally, the foremost dominant codes supplied the basis for categorising the demi-regularities.

5.7 Stepwise framework for critical realist data analysis

The Stepwise Critical Realist Data Analysis Framework proposed by Bygstad et al. (2016) was used to guide the analysis of the generative mechanisms, with CAS theory and Institutional theory providing the necessary theoretical lenses for investigating the mechanisms. CAS theory was used to support the assertion that performance in EMS organisations is emergent and is generated by systematised actions of individual actors interacting with actual technology-enabled emergency response services and with their environments.

Mechanisms are central to the stepwise framework for critical realist data analysis of Bygstad et al. (2016). The framework graphically depicted in Figure 5.6 builds on the methodological work of Wynn and Williams (2012). The aim of the framework is to identify a mechanism that provides the "strongest explanatory power" (p.89) of the observed events.

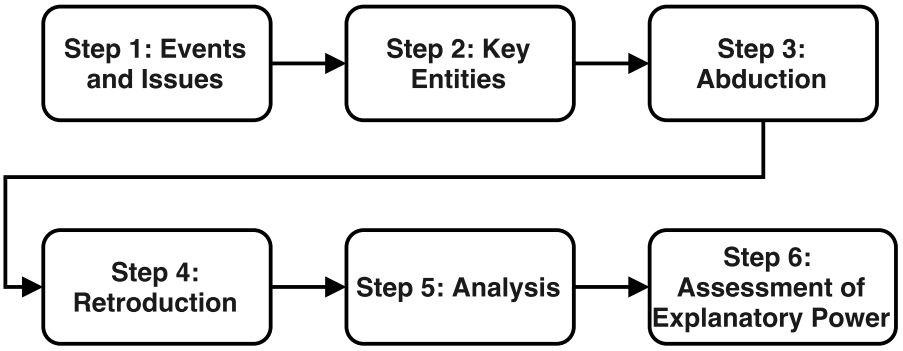

FIGURE 5.6: Stepwise Critical realist data analysis framework. Adapted from (Bygstad et al., 2016)

5.7.1 Step 1: Description of events and issues

Events are observations made by or reported to the researcher using a unit analysis suitable to the area under review (Bygstad et al., 2016). According to Bygstad et al. (2016), these events correspond to the outcomes for which the goal of the research is to develop explanations. The events that were catalytic to variations in organisational performance outcomes were identified by analysing the organisational documents as well as through interviews conducted with participants in the case.

5.7.2 Step 2: Identification of key entities

Key entities comprise both social and material entities with their interrelationships. Consequently, these form structures of networks with emergent causal powers. The Qualitative Content Analysis (QCA) technique was applied to identify elements and entities which allowed the exploration of how these elements may have interacted to give rise to generative mechanisms that influenced regularities in IT-enabled organisational performance outcomes.

5.7.3 Step 3: Abduction/Theoretical Redescription

The third step of the CR stepwise framework involves the redescription of the events, or situations of interest supported by theories about structures and relationships or interactions, as well as the inferential mode of abduction. Danermark et al. (2001), note that "researcher should identify a number of different theoretical interpretations and explanations, and should compare and integrate them where possible." Hence, to remain consistent with the CR ontology, the analysis of the data started with trying to identify the 'demi-regularities' in the empirical domain. While CR recognises that a number of objects, social factors, ideals, ideas, and choices may have some causal influence on reality, these social objects do not necessarily follow the traditional positivist or Humean causal laws of precedence whereby for example, if an event x happens, outcomes y is automatically expected to follow. In CR, these types of constant correlation laws are not possible since the social world consists of open systems, in which multiple events can occur simultaneously, or can overlap (Danermark et al., 2001).

Given that the research takes place in an open system, the researcher was aware of other possible mechanisms that potentially existed, however, not all were necessarily plausible. The purpose of this stage was to theoretically re-describe and abduce the possible and plausible structures and causal mechanisms that may have interacted to generate the events leading to the observed performance outcomes in the empirical domain. The mechanisms that were not relevant were eliminated by focusing on mechanisms that potentially had explanatory power for performance outcomes. Therefore, in stage 3, the focus was on each identified structure and CAS as well as institutional theory were used to theoretically

re-describe the relevant structures. Step 3 ends with the identification of candidate mechanisms.

5.7.4 Step 4: Retroduction

The fourth stage involves the application of Retroduction which focuses on determining how the events or conditions or situations of interest may have developed and occurred, specifically, what possible causal mechanisms might generate such manifestation. Retroduction logically follows from abduction and theoretical re-description as the retroductive step identifies mechanisms that link structures to observed events.

Mingers (2004) notes retroduction as an ideal method for CR. Mingers further suggests that to use retroduction in CR research, hypothetical mechanisms of an unexplained phenomenon must be retrospectively proposed which, if they exist, would lead to the causes of that particular unexplained phenomenon (Mingers, 2004). This allowed the researcher to transcend mere empirical domain experiences. In doing so, further exploration of only necessary structures that exist in the domain of the real can be achieved (Blom & Morén, 2011; Williams & Wynn Jr, 2018). In stage 4, therefore, the focus was on identifying and describing only the necessary and sufficient causal mechanisms that explained performance outcomes. This is discussed further in the data analysis chapter.

5.7.5 Step 5: Analysis of the set of mechanisms

The fifth stage evaluates the competing explanatory power of the identified structures and mechanisms in the third and fourth stages. Chapter 8 provides a comprehensive discussion of how this was achieved. Table 5.5 below, provides a summary illustration of how the data collection phases and analysis are mapped to the three critical realism domains of reality.

CR Domain or Reality	Analytical Method
Empirical	Identification of events and key entities in the case
Actual	Abduction & Retroduction
Real	Abduction & Retroduction

Table 5.5: Mapping realist domain to analytic method from Bygstad et al (2016)

5.7.6 Step 6: Assessment of explanatory power

The final step, known as "Assessment of explanatory power," aims to evaluate the identified mechanisms which best explain the observed events. The mechanisms must be assessed to identify the one with the strongest explanatory power. This process comprises of analysing the various distinctive mechanisms and structures that are revealed in practice. The key aspect of this stage is determining how "mechanisms interact with other mechanisms at different levels, under specific conditions" (Danermark et al., 2001). The purpose of this step is to decipher the meanings of mechanisms as they manifest in the context and provide explanations of the observed events (Raduescu & Vessey, 2008).

5.8 Quality criteria

The Healy and Perry (2000) model was used to assess the quality criteria in this study. The six quality criteria of the model draw from CR's elements of paradigms: ontology, epistemology and methodology and are used to evaluate quality, validity, and rigour in CR research. The six quality criteria are:

1. Ontological appropriateness,
2. Contingent validity,
3. Multiple perceptions of participants and of peer researchers,
4. Methodological trustworthiness
5. Analytic generalisation and
6. Construct validity.

Ontological appropriateness, and *Contingent validity* are primarily concerned with ontology while *Multiple perceptions of participants and of peer researchers* is mainly concerned with epistemology. Finally, *Methodological trustworthiness*, *Analytic generalisation* and *Construct validity* are all three concerned with methodology. The sections to follow discuss how each of the six quality criteria were satisfied in this study.

5.8.1 Ontological appropriateness

Ontological appropriateness which is the first of the six criteria is concerned with CR ontology. It was established in Chapter 3 that the ontology of critical realism is transcendental (Bhaskar, 2008). Consequently, from a CR perspective the nature of reality is objective and some characteristics of this reality may not be directly observable (Avgerou, 2013). This research is concerned with explaining the underlying mechanisms which are not necessarily directly observable, that give rise to performance outcomes in EMS organisations.

5.8.2 Contingent validity

The second of the six quality criteria adheres to CR's notion of causal mechanisms being contingent on enabling or disabling conditions in the empirical context. In other words, "Contingent validity", is concerned with validity about causal mechanisms and the contextual conditions that renders them contingent in the empirical context. In this study, the second criterion was met by concentrating on finding out the mechanisms that enabled organisational performance, by focusing on why and how organisational performance emerged as underpinned by IT rather than simple descriptions.

5.8.3 Multiple perceptions of participants and of peer researchers

CR argues that there is an objective reality which exists irrespective of human's interpretations of reality. Furthermore, CR recognises that humans are fallible and consequently, their interpretations of reality are also fallible. Hence, the third criterion advocates for the use of multiple data sources since CR recognises that participant's perceptions of reality are not necessarily a true reflection of reality. A participant's perception of reality is considered a gateway to true objective reality. Understanding true reality requires a participant's interpretation of reality to be triangulated with other points of view about the same reality. Therefore, CR encourages the use of multiple perceptions about a single reality. In order to satisfy the third criterion, multiple sources of data were obtained from relevant sources in the case. Interviews with different participants at different levels in the organisations were obtained, and participant observations,

organisational documents, and performance data were obtained and triangulated.

Furthermore, several works were presented at peer-reviewed conferences locally and internationally. These include the African conference of Information Systems, the South African Institute of Computer Scientists and Information Technologist Conference and the Americas Conference on Information Systems as well as unofficial events at the University of Cape Town. The goals of these presentations were to request feedback on the interpretation of the findings. Moreover, a Journal article derived from the findings was accepted in the Electronic Journal of Information Systems in Developing Countries (EJISDC) for the 2018 special edition on critical realism and ICT4D. These processes contributed to minimising potential biases and guaranteed the satisfaction of criterion 3.

5.8.4 Methodological trustworthiness

Methodological trustworthiness deals with the degree to which the research methodology can be appraised and evaluated for quality and rigour.Chapter 6 provides a comprehensive description of the case as well as the context.

Concerning the analysis of the data, interviews were analysed using Qualitative Content Analysis (QCA) technique. In order to satisfy the fourth criterion, participants were fully engaged and explained to make sure they fully understood the interview questions. Regarding QCA, the validity of the designed categories depends on the extent to which they capture the central ideas from the interview participants. As some of the subcategories transpired from the data, therefore, the validity of the of categories can be understood to be valid according to definition (Winkelhage et al., 2008).

To further satisfy the methodological trustworthiness, direct quotations from interviews were provided to demonstrate the logic of inferences and ensure trustworthiness of the findings (Yin, 2011).

5.8.5 Analytic generalisation

Analytic generalisation is concerned with theorising plausible explanations of the phenomenon. Unlike positivism whose primary objective is to theory-testing,

the primary goal for CR guided research is theory-building. Therefore, to satisfy the fifth quality criteria, an initial conceptual model was developed from literature which was refined through the analysis of data. A comprehensive final model which explains the mechanisms that give rise to organisational performance in EMS organisation was developed from the conceptual model. The final model is presented in Chapter 8.

5.8.6 Construct validity

Finally, Construct validity evaluates the appropriateness of the methodology used to address the research questions (Drucker-Godard & Bouty, 2007). Hence, it is critical to establish the suitability of methodology used to meet the research objectives. For the sixth quality criterion, Healy and Perry (2000) argue that construct validity in this instance is similar to the positivist account of construct validity, in that it is "how well information about the constructs in the theory being built are measured" in the research.

To satisfy construct validity CAS theory and Institutional theory were used to define the main constructs. When applying Complex Adaptive Systems theory as a guiding theoretical framework, achieving adequate construct validity was challenging. Given that the study was examining unobservable constructs and mechanisms, a critical emphasis was placed on providing comprehensive descriptions that ease potential evaluations of the construct validity. This research study tried as far as possible to provide justifications and motivations for the decision taken in the research design, (i.e., qualitative research design, interviews, participant observations, document analysis and QCA).

5.9 Ethical consideration

5.9.1 University of Cape Town ethics approval

Ethical considerations are principles and regulations guiding the handling of research in specific contexts (Sarantakos, 2005). To conduct any data collection, all researchers the University of Cape Town are required by the university to apply for the mandatory ethical clearance approval. The researcher followed all

the procedures and submitted the required documentation to get approval from the ethics committee before starting data collection.

5.9.2 Western Cape Health Department ethics approval

Given that the study was located in the Western Cape province of South Africa, the Western Cape Health Department (WCHD) requires researchers of health-related disciplines to apply for ethics approval before conducting any data collection in any public health institutions anywhere in the Western Cape.

Authorization to conduct data collection was secured from the provincial research committee — a designated ethics unit with the WCHD which is responsible for managing and granting approval to conduct research in any public health institution in the province. This was after receiving ethics approval from the University of Cape Town's research and ethics committee. All the necessary documentation was submitted, and after a waiting period of two to five months, permission was granted.

5.9.3 Informed consent and confidentiality

For the entire duration of this study, adherence to ethical requirements, responsibilities and agreements relating to the nature and context of this study were strictly enforced. Given the organisational setting and research context, there were a number of important ethical issues that were taken into consideration.

First, the role and relationship between the researcher and participants. The role of agents and participation in the research is important because of issues related to their willingness to participate and/or not participate, the protection of their identities, confidentiality and anonymity and informed consent. Appendix A illustrates the information sheet together with the consent form. All participant agreed to an informed consent to be interviewed. Moreover, as part of the organisational data that was collected, no personal or clinical information was collected from the system, only system performance data was collected. This means that internal data which included people's personal health records were excluded.

5.10 Chapter summary

This chapter provided a comprehensive outline description of the design and methodology guiding the study. The chapter provided concise descriptions of how this study fits in critical realist assumptions of ontology, epistemology and methodology within a case study. Further, in the design of the research, the chapter discussed the use the case study and the CR approach to data collection (tools and techniques) as well as the framework for data analysis. Thereafter, the chapter discussed the CR processes of evaluating quality criteria and what was done meet the quality criteria and to ensure validity and rigour. The study also addressed the ethical issues, which were taken into consideration, particularly the issues of ethics approvals and participants informed consent. Table 5.6 provides a summary of the research design and methodology as discussed in this chapter.

Dimension	**Critical Realist Approach**
Research Purpose	Explanatory
Ontology	Realist (Stratified)
Epistemology	Findings are probably true
Methodology	Single Case study
Strategy of enquiry	Bygstad et al, (2016) CR data analysis framework
Unit of analysis	EMS organisation with an inter-organisational configuration in the Western Cape province, South Africa.
Unit of observation	Participants (employees) of EMS organisation
Interviews Questions	Semi-structured
Causality	Causal structures & Mechanisms
Data Collection	Interviews, Participant observations, Organisational data, Performance data logs
Interviews Questions	Open-ended
Quality criteria	Healy and Perry (2000) model of six quality criteria for assessing quality in CR research
Sample Size	Small
Data type	Contextual qualitative data
Data Analysis	Qualitative Content Analysis
Ethical consideration	Informed consent

Table 5.6: Summary of the research design and methodology

Chapter 6

Contextualisation and case description

6.1 Introduction

This chapter provides a description of the context in which the study is situated. The chapter is structured as follows. Section 6.2 provides a conceptualisation of the EMS institutional environment. Section 6.3 provides a background of the South African healthcare delivery sector. This section also briefly summarises the historical background and the nature of the South Africa's healthcare sector. Thereafter, section 6.5 provides a description of the case understudy; that is, a resource-constrained EMS organisation in the Western Cape province of South Africa. This is followed by section 6.6 which discusses the characteristics of IT-enabled EMS delivery. Section 6.7 provides a summary of the chapter.

6.2 Description of EMS environment

The institutional theory perspective taken in this study theorises that the EMS institutional environment provides regulative, normative, and cultural-cognitive structures which are essential for the provision of EMS. First, regulative structures comprise the regulatory systems for work practices to facilitate delivery of EMS. The regulative structures form the basis for outlining IT usage and decision making in EMS work practices to comply with governance structures

(KPIs/KPAs, environmental rules, and regulations). The regulative structures are conceptualised as the structures that provide a foundation in the minds of the human agents (call-takers, dispatchers, supervisors, managers, and paramedics) that IT usage should comply with existing EMS rules, regulations, and standards as a priority. Examples of these institutional structures include the codes of conducts, such as the national as well as international benchmarks and standards of EMS work practices. Scott (1995) argues that agents can produce and reproduce "taken-for-granted" routines without being fully aware of them, and without enquiring about their legitimacy or efficiency. Hence, it is essential to consider how human actions affect institutions.

Institutional actors are conceptualised as stakeholders that influence operations of EMS organisations. The primary actor being the government which defines and legislates the environmental rules and regulations, including, Key Performance Indicators (KPIs) for EMS organisations. Secondary institutional actors are internal to EMS organisations. These actors enforce the rules and regulations (Supervisors, managers, and senior staff).

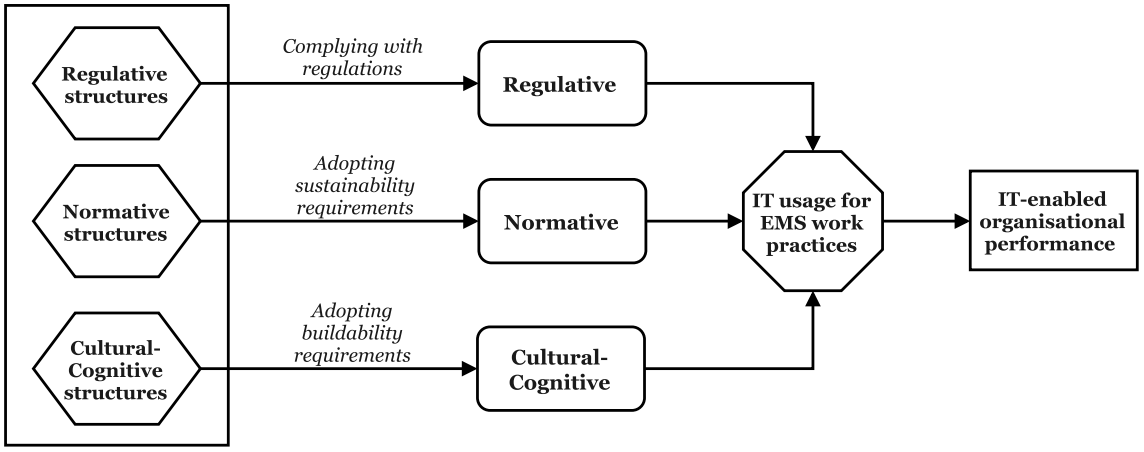

FIGURE 6.1: Institutional structures of the EMS environment

The Normative regulations draw the attention of human agents to moral concerns of the attainment of organisational performance. DiMaggio and Powell, (1991) argue that over time organisations may undergo transformational changes that caused them to resemble other organisations, and thereby become institutionally isomorphic. Like most healthcare organisations, EMS organisations are subjected continuously to isomorphic pressures. This is supported by

the omnipresence of institutions that govern public sector healthcare organisations in South Africa under various healthcare Acts. Cultural-cognitive institutions relate to two properties of culture: (a) the norms that support social orientation to the group rather than individuality which controls social relationships; and (b) cognitive attitudes concerning risk and uncertainty. These require the agents to incorporate the issues relating to organisational performance when using IT in EMS work practices.

6.3 Background of healthcare delivery in South Africa

In 2000, the World Health Organisation (WHO) ranked South Africa (SA) 175th out of 191 member countries in health system performance (World Health Organisation, 2000). This was behind SA's closest neighbours, Namibia, Botswana, and Zimbabwe. Since 2000, the South African government embarked on various programmes to reform its healthcare sector.

In 2008, a total of 8.7% of SA's GDP was spent on healthcare projects. In respect of per capita spending, this was the highest expenditure on health care on the African continent. By 2009 a significant health reform strategy had been devised by the South African Government, the National Health Insurance (NHI) programme, with the aim of achieving universal access to healthcare by the year 2025. This strategy was articulated in the form of a ten-point plan which included priorities such as re-engineering primary health care, improving management and governance of the health system, improving the quality of health services, strengthening human resources for health, and improving access to medicines.

By 2010, the initiative to improve the country's healthcare sector was formalised in a National Service Delivery Agreement (NSDA) (South African Government, 2010). The initiative outlined four critical goals: (a) increase life expectancy; (b) decrease maternal, and child mortality; (c) combat HIV and AIDS and decrease the burden of TB; and (d) strengthen health system effectiveness.

In general, the public health system in South Africa was characterised by numerous problems. These included: lack of resources (e.g., lack of skilled human resources), poor management, over-centralised decision-making, lack of

transparency and accountability, as well as, inefficient health service delivery (Benatar, 2004). The private healthcare sector also faced challenges of its own. These include problems associated with over-provisioning of health services, rising costs and declining purchasing power of users (Benatar, 2004; Chopra et al., 2009; Mayosi et al., 2012). Amongst the four goals outlined by the strategy to reform healthcare, point (d) in particular highlights South Africa's need to improve the health system effectiveness.

In other countries, information technology has played an essential role in transforming healthcare systems (Øvretveit, Scott, Rundall, Shortell, & Brommels, 2007; Poon et al., 2006). In the South African context, information technology has enormous potential to address some of the issues facing South Africa's healthcare system. A recent report by Strengthening South Africa's Revitalised Response to AIDS and Health (SARRAH), cited the need for South Africa's intra- and inter-departmental integration across the health system. The report cites that the " ...*current tendency towards working in silos does not build a common and sustained message of the requirements for the improvement of quality of care* ..." (SARRAH, 2014). The report emphasises the need to improve the quality of health service delivery. Effective and efficient delivery of healthcare services is considered a requirement for the implementation of South Africa's National Health Insurance (NHI).

Emergency health care, which the South African constitution considers emergency healthcare a fundamental human right (Wallis, Garach, & Kropman, 2008) has increased annually by 10% in patient volumes since 2010. EMS plays a vital role in saving lives through the provision of emergency maternal healthcare, given a high infant mortality rate estimated at 45.2 per 1000 and high levels of injuries. These are mainly caused by interpersonal violence and crime-related violence which accounts for a third of all emergency cases.

The average cost of EMS calls to the Western Cape Government is between R600 and R800 per patient. To improve the quality of emergency health care, responsiveness and efficiency, the Western Cape Government embarked on an implementation of an advanced IT system with the aim of improving emergency services in the Western Cape Province at the cost of more than 250 million Rand. The project was initiated in the year 2010 before the start of the FIFA world cup which was held in South Africa.

6.4 Research context: Western Cape Province, South Africa

EMS in South Africa is funded by the government at the national level. Each province, however, manages its own budget and allocation of resources. Contextually, South Africa has nine provinces with the Gauteng province being the economic hub of the country. Gauteng is densely populated with the most significant proportion of resources regarding EMS infrastructure and equipment (Clarke, 1998). Figure 6.2 illustrates the map of South Africa with the nine provinces.

The primary goal of the EMS industry is to provide efficient, quality, effective and timeous emergency healthcare to sick and injured patients. In South Africa, most EMS organisations function in similar ways to each other. Country-wide public EMS organisations share similarities in modes of operations and in the regulations that provide their framework of operation. In addition, each province has regulations based on their socio-economic indicators with which all EMS organisations operating in the province should comply.

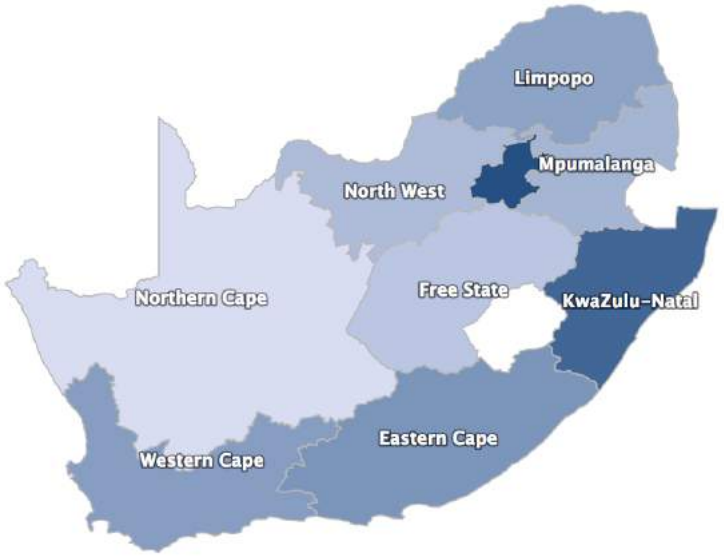

FIGURE 6.2: Map of South Africa (Source: Statistics South Africa, 2018)

Vast infrastructure and resource gaps exist between rural and urban areas. As the most impoverished province, The Eastern Cape many rural areas that are not adequately serviced in terms of EMS and systems (Clarke, 1998). This is due

to budgetary constraints and lack of resources. Regarding cost, patients whose earnings are below a particular threshold qualify for free EMS care (MacFarlane, Van Loggerenberg, & Kloeck, 2005).

The Western Cape Province (Figure 6.3) is South Africa's fourth-largest province with a total surface area of 129 462 square kilometers, which is approximately the size of Greece. It has a population of 5.8 million people (STATS SA, 2011).

Figure 6.3: Map of the Western Cape Province

6.5 Case description

The case under examination is a single-case study of an EMS organisation in a large Western Cape province municipality of South Africa, labelled, for this study, WCEMS. According to Yin (1994), case studies are appropriate for investigating events in the context in which "the boundaries of the phenomenon are not clear."

WCEMS is a public service organisation which provides 24-hour medical response and pre-hospital care service to the public. WCEMS is one of the largest EMS services organisations in South Africa. WCEMS' strategic goal is defined as:

> "To render effective and efficient pre-hospital emergency services including inter- hospital transfers and patient transport in the Western Cape. "

— **WCEMS strategic goal***(Source:WCEMS)*

Several responsibilities and activities of WCEMS can be derived from the stated strategic goal. The primary responsibility is to deliver efficient and effective EMS services to the public. Efficient implies fast response with minimal resource use while effective implies the quality of care.

WCEMS consists of medical emergency response and transport. As an organisation, WCEMS is made up of approximately 2000 personnel. These include ambulance paramedics, call takers and dispatchers. It consists of six control centres, of which five are located in rural areas. Transport comprises HealthNET, a specialised unit which deals with the transportation of non-emergency patients. The organisation responds to more than 515,000 emergency cases per annum (DOH, 2014).

6.5.1 Organisational structure

Organisational structures can be divided into two types (1) social structures and (2) technical structures. According to organisational theory, the concept of 'structure' is used, to refer to either the social structures and the technical structures associated with the organisation, by which an organization produces collective action (Sheaff et al., 2003, p.26). The social aspect of structures can be described as the long-lasting social relationships through which the organisation's hierarchy (leaders, senior management) control other members' behaviour in order to achieve and attain the organisation's objectives. Normally, these social structures constitute a subcategory of intra-organisational interactions between different agents, which become often routinised. It includes the design of the organisation (vertical and horizontal), that is, the hierarchical definitions of roles and responsibilities as well as the spheres of influence and authority. It also includes the level of specialization and the technical separation of labour among organisational units.

In terms of the organisational design, WCEMS is made up of five departments. These departments are responsible for different functions within the broader WCEMS organisation. Figure 6.4 provides an illustration of the broader organisational structure of the WCEMS with the different departments.

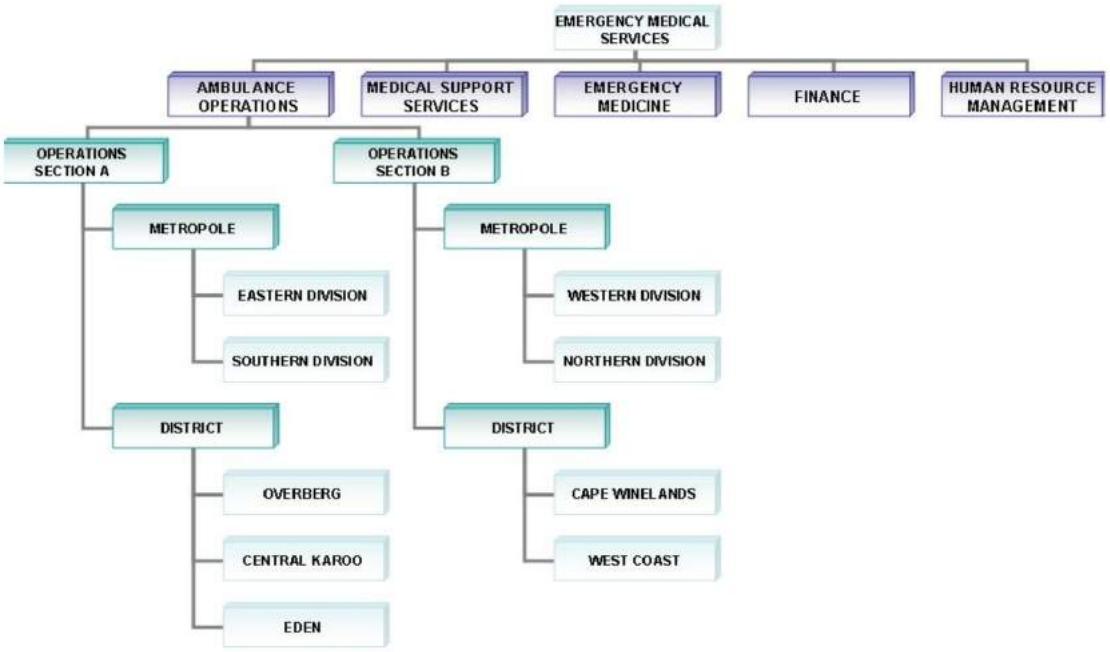

FIGURE 6.4: WCEMS organisational structure

The Ambulance Operations department is tasked with providing WCEMS the necessary resources to enable responding to emergencies throughout the province. The Medical Support Services (MSS) department is responsible for providing the required, infrastructure, workforce, facilities and equipment to allow receiving emergency calls. The department also is in charge of directing, controlling and managing all the WCEMS resources which are provided by Ambulance Operations department. It is under the MSS department, that Information and Communication Technology Services (ICTS) is located, which is a major role player in the operational processes of WCEMS. Figure 6.5 provides a depiction of the MSS substructure.

The Emergency Medicine department is responsible for providing training and emergency medicine education to the EMS staff. This department is linked with formal training programs offered at two leading public universities in the Western Cape (University of Cape Town and Stellenbosch University). Finance department is responsible for managing the WCEMS finances while the Human Resource (HR) department is responsible for managing the HR needs of WCEMS.

The second aspect of structure are the technical structures. The technical structures are made up of technical knowledge and other physical resources such

FIGURE 6.5: WCEMS Medical support structure

as, in the context of this study, Information technology, ambulances, tools, resources, etc.

6.5.2 Resource constraints

EMS organisations in South Africa have a constitutional mandate to provide high quality EMS to the public. The provision of such services require access to resources. In this study, 'resources' have been defined to include human resources, material resources (Ambulances and medical equipment), funding and knowledge. Unfortunately, given South Africa's past history, the government faces many healthcare challenges and is forced to under-fund EMS organisations. The lack of National funding for EMS organization create problems of resource constraints for all EMS organisations in the country. As a result, Provincial health departments are forced to manage their budgetary allocations in ways that suit the demands of emergency services in respective provinces.

In the case of WCEMS, resource constraints are mainly a result of two factors. First, is the nature of the EMS work practices and the extent to which EMS organisations depend on their external environments. The external environment includes the wide public, hospitals, clinics and the nature of unpredictable high demands of emergency services. These demands are mostly generated by high

crime levels that exist in South Africa. The second factor is the problem of resource ownership. WCEMS normally depends on Government to supply material resources because of the EMS funding model that exist in South Africa. All EMS organisations depend on Government funding for sustainability. These creates a high resource dependency on the government. In turn, these resource dependency place constraints on EMS organisations to use the fewer resources capacity provided by the Government.

6.6 Characteristics of IT supported EMS delivery

In total, WCEMS is made up of six operational centres in the Western Cape province. These are further subdivided into into two sections: Operations A and B (see org. structure). The section managers are responsible for the management of the metropole divisions and other district operational centres.

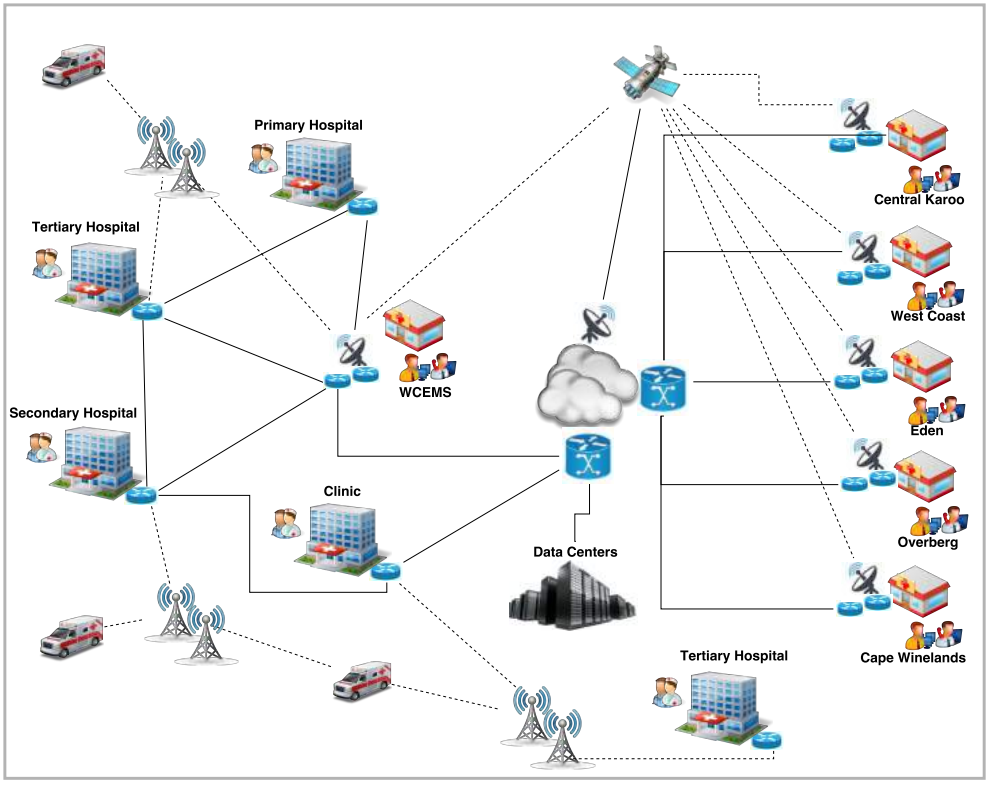

FIGURE 6.6: WCEMS inter-organisational information system

While most regional EMS centres were impacted by the Western Cape Department of Health (WCDoH) mandate to improve performance, some centres experienced moderate levels of performance improvements, For example, as illustrated in Table 6.1, some of the key indicators of performance like priority 1 (P1) (life threatening emergency cases) in urban areas failed to meet the mandated targets set by the department of health. There was a moderate increase in completion times (time to complete patient logging and transporting) as a result of the implementation of the digital inter-oganisational computer aided dispatch system.

TABLE 6.1: Performance targets vs actual targets achieved

Programme 3: Emergency Medical Services					
Strategic objectives	**Performance indicator**	**Actual achievement**	**Planned target**	**Actual achievement**	**Deviation ***
		2013/14	**2014/15**	**2014/15**	**2014/15**
STRATEGIC GOAL 1: Address the burden of disease.					
1.1 Fully implement the Comprehensive Service Plan (CSP) model for EMS by 2014/15.	1.1.1 Rostered ambulances per 10 000 people	0.28	0.27	0.26	(0.02)
	Numerator:	166	167	158	(9)
	Denominator:	600	613.079	613.079	0
1.2 Provide roadside to bedside definitive emergency care with defined emergency time frames within and across geographic and clinical service platforms.	1.2.1 EMS P1 urban response under 15 minutes rate	70.9%	75.0%	61.0%	(14.0%)
	Numerator:	130 899	144 225	112 100	(32 125)
	Denominator:	184 584	192 299	183 694	(8 605)
	1.2.2 EMS P1 rural response under 40 minutes rate	85.3%	90.0%	83.1%	(6.9%)
	Numerator:	25 234	27 678	23 972	(3 706)
	Denominator:	29 588	30 754	28 844	(1 910)
1.3 Manage all patients at the appropriate level of care within the appropriate packages of care.	1.3.1 Percentage of ambulance patients transferred between facilities	23.0%	22.8%	20.4%	2.3%
	Numerator:	169 450	171 247	176 945	5 698
	Denominator:	739 981	751 820	864 912	113 092

Being one of the largest EMS organisations in South Africa because of the number of emergency cases it managed, for WCEMS the common goal was to improve patient outcomes and delivery of quality healthcare. The organisational performance was critical in this regard. WCEMS business and technological processes played key roles with IT central to improving performance outcomes. The use of IT in WCEMS to support emergency service delivery had a significant

impact on the work practices and business processes of WCEMS. This was because IT played a fundamental role in the communications and coordination of all WCEMS operations. The IT artefact consisted of a Computer Aided Dispatch system and performance reporting systems bundled into one EMS system with multiple levels of access.

Due to various inefficiencies and challenges associated with poor performance management, WCEMS required a new Computer Aided Dispatch system to manage emergency service delivery. The process of implementation of a new CAD system was completed by 2014. However, there were on-going system enhancements and adaptations of the system.

> "...We embarked in 2010 for a new CAD system for communication center, one of the reasons was to get better information, and the main reason was to get any emergency resource quicker to the incident. However, in the year 2010, the technology that existed was inadequate, so in 2013, we had to amend our specifications because of the new technology that came to the market. And one of the reasons why there is more integration is because we had to change some of the requirement specifications after the new technology that came to the market..."
>
> **— Manager#4**

TABLE 6.2: Time line of events

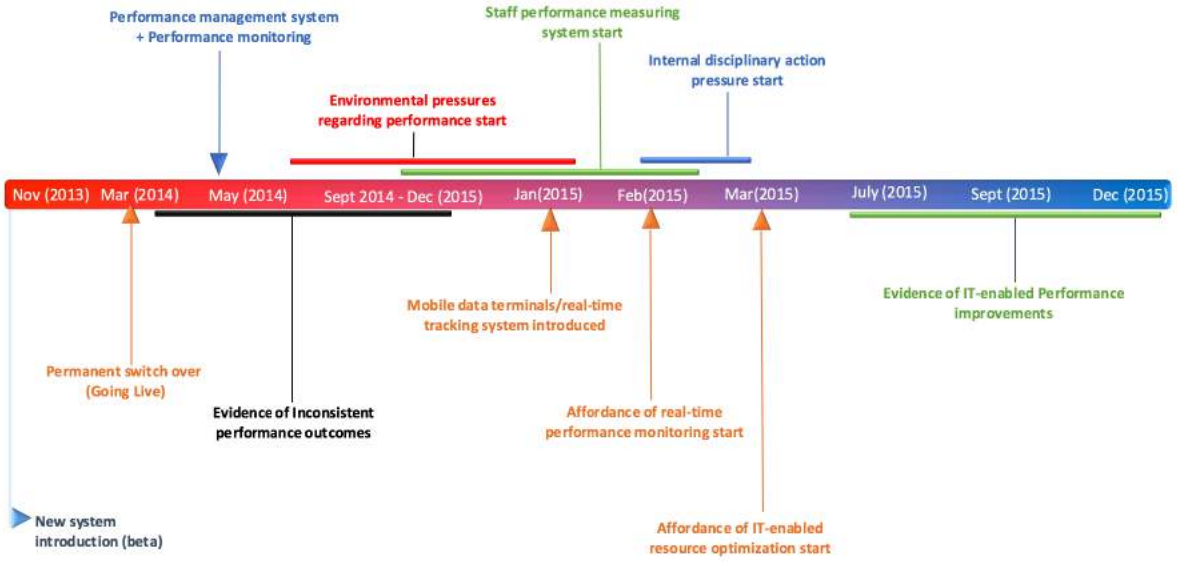

Figure 6.2 provides a time line of the events. The IT artefact consisted of multiple applications integrated into a complex system. The CAD system comprised a suite of applications including a call-taking and dispatching application, a Mobile Data Terminal (MDT), a Patient Data Terminals (PDT), The Patient Transfer System (PTS), a business intelligence component that was later added as well as an Enterprise Resource Planning (ERP) system. Parallel to the CAD system a dedicated events (for example, marathons, cycling events) application was added to the main suite. All the applications were integrated directly with the CAD and implemented at the remaining five control centres that the six control centres had a uniform CAD system.

The ERP had two components. One was a Fleet Management System (FMS), and the other was a Human Resource (HR) application which was responsible for the management of the staff. The PDTs were used by the practitioners to capture patient information which was sent to the stakeholder hospital wall-boards so that the medical practitioners and other hospital staff could see beforehand what kind of patients were en route to the hospital, the different triage categories of patients, what was wrong with the patients, and the general condition of the incoming patients.

6.7 Chapter summary

This chapter presented the contextualisation and case description in which the study is situated. A comprehensive description of the case under study was provided; which is, a resource-constrained EMS organisation in the Western Cape province of South Africa. In addition, the chapter summarized the characteristics of IT-enabled EMS delivery. The chapter to follow presents the data analysis.

Chapter 7

Data analysis

7.1 Introduction

This chapter presents the analysis of the data. Section 7.2 describes how the critical realist stepwise data analysis framework was applied. For brevity, the framework is referred to as the 'stepwise framework' in this study. The subsequent three subsections describe the application of phases of the stepwise framework. Section 7.3 presents the description of the events and issues, section 7.4 presents the identification of key entities in the case, and section 7.5 presents abduction/theoretical re-description. In section 7.6 candidate mechanisms are identified. Section 7.7 concludes the chapter with a review and summary.

7.2 Application of the stepwise framework

The interview transcripts were combined with the organisational documents, annual reports, policy documents and related documents, collected from WCEMS and the Western Cape Department of Health (WCDoH) to analyse the data. These documents were combined with participant observations about the daily operations of the WCEMS organisation. The first three steps of the stepwise framework are presented below. Steps 4 through 6 are discussed in Chapter 8 which presents the discussion of the identified mechanisms.

7.3 Step 1. Description of Events and Issues

The first step in the stepwise framework is the identification of the key events in the case. According to Bygstad et al. (2016), events correspond to the concrete observed organisational outcomes for which the research goal is to develop explanations. Through analysis of the organisational documents and interviews, catalytic events were identified events that influenced organisational performance. Three key events were distinguished based on how they impacted the operations of WCEMS. (1) Poor performance outcomes, (2) poor resource management, and (3) improved performance brought about by IT investment.

7.3.1 Poor and inconsistent performance outcomes

The complex and unpredictable nature of emergency services renders large-scale emergency services dependent on a number of factors and environmental dynamics. For example, demand for emergency services is often triggered by unpredictable external factors such as crime, which causes the number of people requiring emergency services to surge. In WCEMS, these surges were made worse by continual poor and inconsistent performance outcomes. Figure 7.1 illustrates the inconsistent performance outcomes of a typical month, in this case, September 2014. For example, on the first day of September 2014, WCEMS only responded to 56.8% of P1 emergencies.

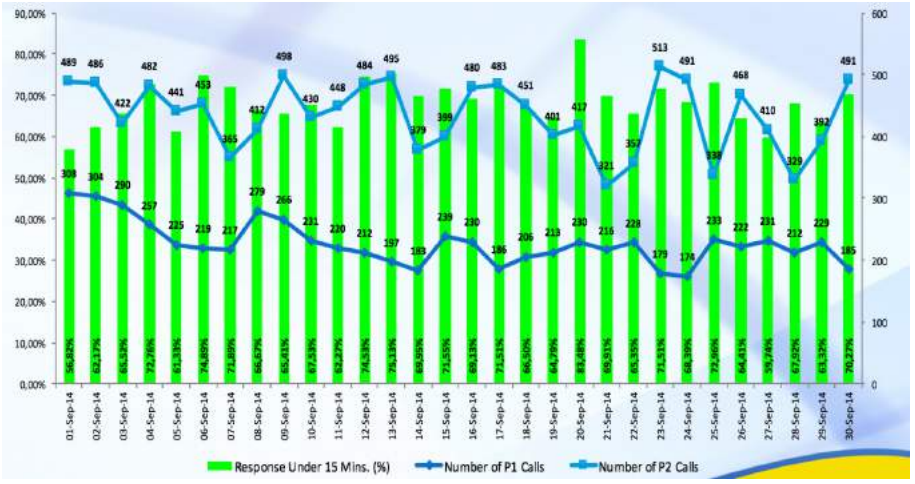

FIGURE 7.1: Performance patterns

The remaining 43.18% of P1 emergency cases were attended to outside of the 15-minute threshold mandated by the Ministry of Health in South Africa. This translates into 133 life or limb threatening emergencies which were not attended to because of resource shortages. The inconsistent performance pattern continued throughout the entire month, even though performance fluctuations were observed.

7.3.2 Poor management of inadequate resources

As WCEMS was dependent on government funding, they did not have the financial capital to purchase their own resources. Even so, increased material resources (for example, ambulances) were observed to have little impact on performance outcomes. This was attributed to poor resource management which in turn affected the performance patterns of WCEMS.

7.3.3 IT-enabled improvements in performance outcomes

In 2014, WCEMS implemented a state-of-the-art information communications technology system to improve its operational ability. The technology aimed to improve organisational performance through operational efficiencies across the organisation. Use of the technology was expected to improve response times, quality of services, and clinical outcomes. However organisational performance although initially was poor, performance later improved.

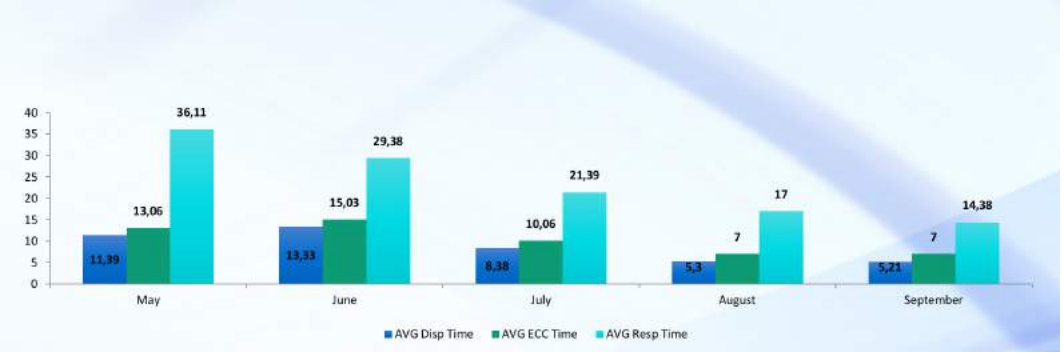

FIGURE 7.2: Month to month improvements in performance patterns

According to regulation, WCEMS is required to respond to P1 emergencies under 15 minutes. As can be seen from Figure 7.2, IT helped to improve the average

time it took to respond to emergency incidents from an average response time (Resp Time) of 36 minutes in May to 14 minutes in September of 2015. There was also an improvement in the average time it took to dispatch (Disp Time) ambulances to scenes of emergencies. Finally, as illustrated the average time (ECC time) process the emergency incidents that were received by WCEMS also improved from a dismal 11 minutes in May to 5 minutes in August. The important role the IT played in improving performance was acknowledged by managers.

> "...this thing wouldn't operate without IT. Back in the day it was radios and little control room. But now capturing patient details, just making sure you've got you have the right resources going to the right patient because we don't necessarily send the closest available resource to the patient, We send the most the appropriate closest the source to that incident.
>
> **— Communication Manager#1**

7.4 Step 2: Identification of key entities

Key entities consist of both social and material entities together with their interrelationships. Consequently, these form structures of networks with emergent causal powers. From a social perspective, key entities include ambulance paramedics, call-takers, dispatchers, supervisors and control center managers. WCEMS comprised of six control centres, five of which were located in rural areas.

From a material perspective, WCEMS consist of medical emergency response, transport, and IT systems. IT systems include the Computer Aided Dispatch (CAD) system and performance management systems implementations with real-time vehicle tracking systems and Mobile Data Terminals (MDTs). The IT system is central to all activities (call-tasking and ambulance dispatching) in WCEMS. Secondly, the performance management processes and thirdly the mobile data terminals and vehicle tracking system. These events are discussed in more detail in the subsequent sections.

Analysis of documents indicated that there were three dimensions to business processes in EMS that enabled the management and delivery of emergency services. These are; First, the business services dimension, which consist of three

important business processes: (a) incident management, (b) patient emergencies and (c) Non-emergency transport. Second, the operational process dimension which consist of the primary processes: (a) call-taking, (b) resource optimisation (c) emergency dispatching and (d) fleet management. Third and finally the enablers dimension. This dimension consist of information management and IT infrastructure services. Figure 7.3 illustrates these three dimensions.

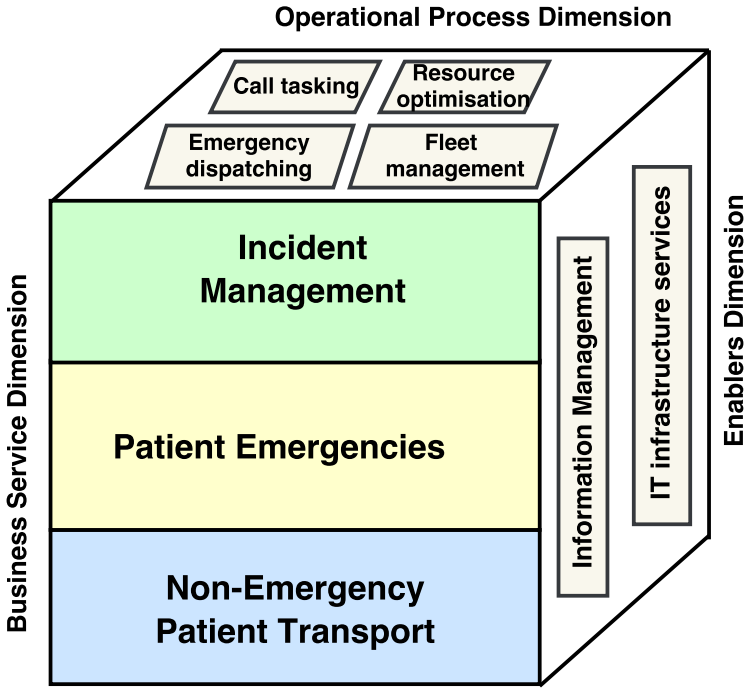

FIGURE 7.3: WCEMS business process

A cycle of increased investment and additional personnel had no positive effect on KPIs as was anticipated in each intervention. Further examination showed that although technology was available, it was not being utilized efficiently or at all in some instances.

7.5 Step 3. Abduction/Theoretical Re-description

Abduction or theoretical redescription involves interpreting and re-describing the various aspects of the phenomenon from a theoretical perspective (Danermark et al., 2001). Abduction allows redescribing the empirical data through

theoretical concepts (Fletcher, 2017). Danermark et al., (2001, p. 205) define abduction as a process of "inference or thought operation, implying that a particular phenomenon or event is interpreted from a set of general ideas or concepts".

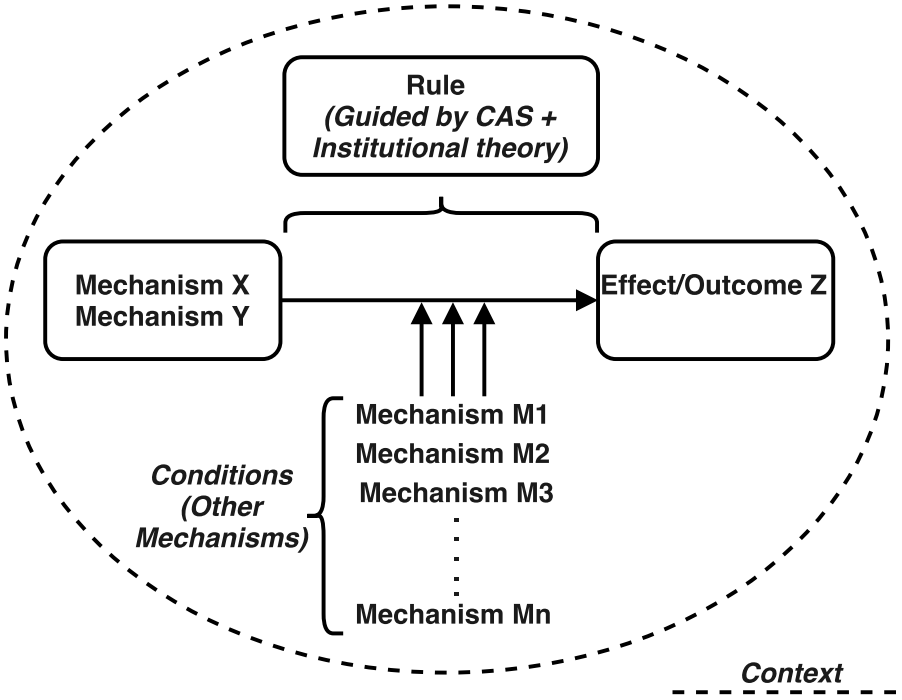

FIGURE 7.4: Application of abductive reasoning (Adapted from Danermark et al. (2001))

The critical realist view of abduction argues that given a particular outcome, and a known rule, it is possible to abduce the mechanisms that gave rise to the observed outcome in the empirical domain. As shown in Figure 7.4, the outcome is the improved performance outcomes that are enabled by IT.

CAS theory and Institutional theory were used to theoretically re-describe the rule to abduce the potential mechanism that gave rise to the outcomes. CAS theory provided a definition of interactions which shed light on how agents interacted with each other as well as with IT to deliver emergency services. However, these interactions were influenced by institutional structures. Hence, institutional theory allowed investigation of how institutional structures influenced organisational performance within the context of resource constrained EMS organisations.

7.5.1 Application of theoretical re-description

In the third step of the stepwise framework, CAS theory and Institutional theory were used as lenses in order to abduce the generative mechanisms from the concrete outcomes. In particular, consistent with Nan's (2011) conceptualisation of CAS model of IT usage, three key entities were identified. These are:

- Human agents (e.g., IT users): These included managers, supervisors and regular users of IT such as dispatchers and call-takers.
- IT Artifact: The main IT artifact in this case was the Computer Aided Dispatching (CAD) application which was explored (e.g., the IT (CAD) application features). In addition, the main business processes and IT architecture were also delineated.
- Contextual structures: In the third step, participantsâĂŹ interview transcripts were analysed using qualitative content analysis as described in Chapter 5. This allowed identification of factors and key entities and enabling contexts that may have interacted to give rise to the generative mechanisms.

The section to follow presents the findings from the analyses of these elements in order to abduce the generative mechanisms.

7.5.2 Analysis of agents

The main system users were human agents who were directly responsible for the computer-aided dispatching emergency services and understood the use of IT as central to delivering emergency services. Agents' progress and hourly performance were tracked through performance measurement mechanisms which were built into the IT applications. As illustrated in Table 7.1 and Table 7.2, the core constructs of CAS theory, adapted from Nan (2011), were mapped to the concepts of IT use relevant in this study. The building blocks of the CAS model of IT use were considered in line with the model illustrated in Figure 4.4.

TABLE 7.1: Coding table for analysis of agents

CAS Construct		IT Use Construct	Formal definition	Empirical definition	Example of Codes	Where to find observations in the data
Agent		Human actors	The individual users involved in IT use processes including IT novices and IT experts	WCEMS agents that are responsible for provision of emergency services,	Users, managers, supervisors, agents	- Employees of WCEMS and their respective functions
		IT features	The building blocks or basic components of a system such that enable the management of resources and performance management	CAD flexibility	Call Dispatching, call taking, tracking	- Creative usage of resources (human) and material (ambulances) to suit the demand of emergency services.
Agent (Sub concept)	*Attribute*	Individual differences	The internal states of human actors such as demographic backgrounds, cognitive styles, attitudes towards performance and personality traits	Individual differences	Learning, disagreements	- Empirical evidence of the ability to learn from their own experience and adapt to new, unexpected conditions
		Technology characteristics	The internal states of IT features such as system reliability, flexibility, and richness	CAD flexibility	Easy to use Difficult to use Make life easy	- CAD System Features that enable the organisation resources and delivery of emergency services
	Behavioural rule	Cognitive activities	The cognition and emotions of human actors in their work tasks	Learning from CAD system Features, Social learning	Stressful, Stress emotional	- Empirical evidence of WCEMS agents altering their behaviours by performing work activities that are not directed by predefined rules and norms in the organisations.
		IT functionalities	The set of functions or capabilities delivered by IT features such as information access and performance management	A set of constraints and enablements realized in practice by the appropriation of the CAD system	Call dispatching Performance tracking Performance management Vehicle Tracking Vehicle Dispatching Rostering	- The capability inscribed in the features to adapt to the majority practices of employees

IT users who were part of the WCEMS were identified as enabling agents given that they used IT to perform work tasks that facilitated delivery of emergency services and the attainment of organisational performance objectives.

Depending on the research phenomena, Nan (2011) argues that agents can represent different elements of a complex adaptive system (e.g. "Human beings, organisations, objects, or concepts"). The analysis revealed a number of human agents that played a major role in the use of IT in the case. These include managers, supervisors, dispatchers, and call takers.

7.5.3 Analysis of interactions

Within the WCEMS case, several instantiations of interactions were observed. Table 7.2 illustrate how the coding for the analysis of interaction was done.

Based on Nan (2011), the interaction construct and sub-construct were mapped to IT-use constructs.

TABLE 7.2: Coding table for analysis of interactions

CAS Construct		IT Use Construct	Formal definition	Empirical definition	Example of Codes	Example of empirical observations in the data
Interaction		User-system interactions	The mutually adaptive behaviours between human actors and IT features	Mutually adaptive behaviours between employees and IT business processes, and CAD features.	System usage,	- Empirical evidence of Continuous cycles of planning, learning, responding and adapting to EMS environment based on interactions between agents, the CAD system and the EMS environment. - Evidence of different interacting elements (people, processes, technology, information, etc.) within the WCEMS
		Interpersonal interactions	The mutually adaptive behaviours between human actors	Interpersonal relationships among WCMES employees	Resource sharing Filling in Collaborate	- How different agents interact, communicate, collaborate to respond to emergency medical services in more than one way, - Evidence of team work, - Mutual-influence behaviours of WCEMS employees
Interaction (Sub concept)	*Connection*	User-system links	The direct uses of IT features	Direct uses of the CAD system	Individual performance monitoring Dispatching, Call taking	- Empirical evidence of user usage of the CAD system. These includes modifications or CAD appropriation to suit their work tasks (e.g., dispatching, performance monitoring, reporting)
		Interpersonal ties	The relationships between human actors	Interpersonal relationships among employees	Resource management scheduling	- How individual agents (staff of EMS,) interact between themselves with respect to resource sharing, collective action, collective attitudes towards performance and emergency service provision
	Flow	Movement of intangible IT resources	The distribution of knowledge, information, beliefs, and other intangible IT resources among human actors and IT features	Resource transfers (Resource sharing, Knowledge transfer)	Knowledge transfer, Knowledge sharing, Resource sharing	- Empirical evidence of independent agents acting together and unknowingly developing over time coordinated strategies to enhance their work tasks.

In the WCEMS case, interactions were primarily underpinned by IT which facilitated effective collaboration between agents. For example, prior to the implementation of the CAD system, the interactions between ambulance paramedics and ambulance dispatchers in the emergency control center was poor due to the use of old radio technology communication. As a result, data would get misinterpreted creating inconsistencies and inaccuracies. It was observed that these inconsistencies and inaccuracies were mostly the result of unclear radio communications, different accents between dispatchers and paramedics and signal loss between ambulances and the control center.

The errors caused by the inconsistencies and inaccuracies resulted in further delays in ambulance dispatching. The delays had serious implications on delivery of emergency services and potential loss of lives. To minimise these errors (data

inconsistencies and data inaccuracies), Mobile Data Terminals (MDTs) were introduced in the ambulances to improve the accuracy of communication, data transfer between ambulances and control centres as well as to improve the accuracy of incident locations and navigation. The interactions between WCEMS and ambulances eliminated most issues associated with data inconsistencies, data inaccuracies, data loss and further afforded a simplified method for ambulances to navigate to incident locations by a simple click of a button. A vehicle tracking system was also introduced which allows the emergency centre to track in real time the locations of the ambulances.

Drawing from the participant observations and interviews conducted with different respondents at various levels of the organisation, an analysis drawing on the CAS IT model of use can be summarized as follows: empirical evidence suggests that participants communicated and interacted as members of their organisational group/team. This was further strengthened by the difference in attitudes each group/team had towards performance, of which was influenced by the different preconceived values, belief systems as well as assumptions and concerns each group/team had.

> "... Some agents know that their performance has an effect on the performance of other agents and so on ... So sometimes, you get a few dispatchers that would ask the struggling dispatchers for assistance in terms of resources (vehicles)..."
>
> **— Supervisor#3**

The analysis here can be summarised as: agents and resources in EMS organisations are often intertwined in feedback loops and complex interactions (agent to agent, agent to resource and agent, resource, environment interactions). As a result, the formation of interpersonal interactions can be instrumental in influencing the actions of individuals within the broader organisation and subsequently impacting organisational performance.

7.5.4 Analysis of IT features

From the interview data, the frequently reported advantages of system usage, five features resulting from the interactions between agents and the CAD system

were identified. These are:

1. Incident/case registration
2. Ambulance dispatch
3. Standardizing
4. Case status monitoring and reporting
5. Controlling

These five features were fundamental to analysing how IT enabled organisational performance was realised through the use of the features of the IT artifact (CAD system). The analysis also investigated how the EMS system constrained and/or enabled delivery of EMS work tasks, as well as, how the staff (call takers, dispatchers and paramedics) interacted with the features of this EMS system. Each feature is linked to the specific actions taken by agents to actualise those features. Table 7.3 elaborates on the five CAD system features. The features are contrasted with the goal oriented actions, the affordance feature provides and the perceived benefits for emergency care delivery.

Participant observations together with interviews from call-takers and dispatchers acknowledged that the CAD system supported the execution of core WCEMS processes such as call-tasking, incident details capturing and registration, location identification, ambulance dispatching, and reporting. The CAD system allowed call takers to categorise and sort emergencies, based on a set of predefined questions — which were answered by the caller — the high and low priority cases. The high priority cases were internally referred to as P1 emergencies. P1 cases include for example: life threatening or limb threatening injuries; motor vehicle accidents; gun violence related injuries; cardiac arrests cases and children under 7 years old. All other emergencies that were deemed not life-threatening or limb-threatening were categorized as priority 2 (P2). The CAD system also analysed the captured records for performance reporting purposes.

Furthermore, the CAD system also enabled integration with mobile devices installed in ambulances for real-time status update. These devices facilitated for the updates of both ambulance and patient information back to the emergency management center from the time the ambulance was dispatched to the time the patient was handed over to the tertiary facility (hospital or local clinic).

Table 7.3: CAD system features

IT features	Goal-oriented actions	Enabling EMS system features	Perceived benefits for care delivery
Incident/case registration	To capture and register all incident related data, including patient data, location, caller details, etc.	Systematic capturing of all case related data into case database	Detailed patient location data, caller information, patient data and case related data for emergency case registration. Once case is registered, it is automatically becomes available to the relevant dispatchers' board for dispatch of ambulance.
Ambulance dispatch affordance	To dispatch ambulance to the scene of emergency	Intelligent dispatching of incident relevant ambulance	Based on incident data captured and registered by call takers, CAD system allows to intelligently dispatch the relevant ambulance with correct resources to the scene.
Standardizing affordance	To perform all emergency medical response activities through the CAD system	Provided standardized business process workflow for: 1. Incident Case registration 2. Location identification 3. Priority categorization 4. Dispatching of ambulance 5. Case status reporting	Standardized incident data capturing and dispatching of ambulance to emergency scene. Effective management of mission time through regular case status updates
Case status monitoring and reporting affordance	To monitor and report on the case status for each emergency case from the time of call registration to ambulance dispatch to patient handover to hospital	System allowed ambulance paramedics to update case statuses for all dispatched cases in real time.	Managers were able to view case status reports which were aggregated by how many P1 and P2 cases dispatched as well as outstanding.
Resource Control	Controlling of resources (human and material)	System allowed to control the available resources and optimize the use of resources based on the demand of emergency services	Managers were able to devise strategies to minimize the number of outstanding P1 emergencies. Supervisors were able to reshuffle resources based on emergency demand.

Moreover, the CAD system was designed to support and enhance managerial performance management routines. Supervisors and managers are able to access reporting features of the system which allowed them to monitor individual performance for each call taker and dispatcher. The system also facilitated monitoring of all dispatched as well as unattended or outstanding P1 and P2 emergency cases resulting from a shortage of resources (human and material). From these performance reports, managers devise strategies aimed at minimising the number of P1 emergency cases in order to meet the organisational performance targets and compliance with the requirements from the Department of Health (DOH). Consequently, managers devise strategies that deal with the changes and disruptions emanating from within or external to the WCEMS organisation.

7.5.5 Institutional structures in WCEMS environment

The institutional theory perspective has generated substantial explanations of the significance of institutional environments with respect to organisational structures and actions (Currie, 2009; Teo, Wei, & Benbasat, 2003).

For the analysis of the WCEMS environment, Scott's (1987; 1995) institutional theory perspective was adopted as a theoretical lens through which WCEMS organisational environment was examined. Table 7.4 shows the result of the coding for the analysis of the institutional environment.

Table 7.4: Coding table institutions

Theme	**Categories**	**Sub-coding variables used in data analysis**	**Keywords:**
Regulative	EMS Regulations	Sub code 1: External - Government Mandate	Formal, external, regulations, legal, requirements, compliance
		Sub code 2: Internal – Complying with EMS regulations	Formal, internal, company policies, procedure, corporate authority
Cultural-cognitive	WCEMS Company culture	Sub code 3: Parent organization	Informal, corporate culture, management decisions, top-down
		Sub code 4: Employee preference, Cultural influences	Informal, corporate culture, employee influence, employee dedication
	Country culture	Sub code 5: Local culture	Informal, national culture
Normative	Performance Benchmarking	Sub code 6: Outside-in	Influenced by externals, comparing to others, organizational modeling, peer pressure
		Sub code 7: Inside-out	Influencing others, wanting others to compare to you, organizational modeling,
	Long term EMS Sustainability	Sub code 8: Training, Education	Educational similarities, cognitive legitimization.
	Professionalization	Sub code 9: Company networks	Exchange of information, collaboration, external, partnerships, networks

The environmental structures normally refer to the interactions of the organisation with formal legal processes defined by Government and other external

stakeholders. These include amongst others, the laws and regulations on how an organisation in a particular industry should conduct its operations. Together these structures form the structures by which an organisation implement or should follow, in order to achieve its objectives. For the analysis of the WCEMS environment, three types of institutional structures were identified using institutional theory lens. These are (1) Regulatory, (2)Normative and (3) Cultural cognitive. Each of these are discussed below.

7.5.6 Regulatory/Legal institutions

Analysis of organisational documents revealed that organisational performance was measured against a number of KPAs and KPIs. The main objective of WCEMS was summarised by WCEMS's organisational mission statement as "*To render effective and efficient pre-hospital emergency services including inter-hospital transfers and patient transport in the Western Cape*".

WCEMS' mission statement was the basis of the KPI definitions which were used to measure organisational performance. These KPA and KPIs were found to be multi-dimensional and reflected the interests of a number of stakeholders particularly the government to whom performance outcomes were reported. Figure 7.5 illustrates the KPIs governance structures for which WCEMS' performance outcomes were assessed.

WCEMS was required to operate within these regulatory structures or governance frameworks defined by the Western Cape Government Department of Health. These KPA/KPIs provided structures aimed to govern all emergency service operations in the Western Cape province. WCEMS was expected to regularly report their performance to the minister's office. As such, the regulations and enforcement of these rules affected operations of WCEMS.

Furthermore, the analysis of secondary data (organisational documents) revealed that there were four critical constitutional mandates and over 73 national legislative and policy mandates that formed an operational framework with which WCEMS was required to comply and implement. These legal structures were normally enforced by the government and industry standards. The National Government Act governing the delivery of emergency services in South Africa engaged all the provinces in delivering healthcare services to the public. This

Strategic objective	Measurable objective	Performance indicator
Improve response times to emergency scenes in all areas. (Provincial)	**Increase the number of all responses in less than 30 minutes.**	Percentage of all emergency responses in less than 30 minutes
	Increase the percentage of telephone calls answered within 12 seconds to 70% by 2010.	Percentage of telephone calls answered within 12 seconds
	Evaluate the performance and utilization of HealthNET	No. of Kilometres travelled per month
		No. of clients transported per month
		No. of HealthNET cases expressed as a percentage of the total population
	Ensure the provision of an effective and efficient aero-medical service	No. of missions completed on the rotor-wing program - Cape Town
		No. of patients transported by rotor-wing - Cape Town
		Efficiency of rotor wing program - Cape Town (= no. of patients / no. of missions)
		No. of missions completed on the rotor-wing program - Oudtshoorn
		No. of patients transported by rotor-wing - Oudtshoorn
		Efficiency of rotor wing program - Oudtshoorn (= no. of patients / no. of missions)
		No. of missions completed on the fixed-wing program
		No. of Kilometres flown by the fixed - wing program
		No. of patients transported - fixed-wing program
		Efficiency of fixed-wing program (= no. of patients / no. of missions)

FIGURE 7.5: WCEMS KPIs

Act was aimed at regulating how EMS services are delivered, the quality of care and the necessary contingencies needed for delivering emergency services.

Regulatory frameworks provided standard performance requirement levels that necessitated WCEMS to aim for accreditation standards as well as monitoring to ensure quality improvements levels defined by the government and other local and international regulatory bodies at multiple levels. These regulatory frameworks and standards played a fundamental role in shaping WCEMS's performance management systems. According to EMS regulations, emergency paramedics are required to, "as quickly as possible, assist sick and injured patients before they are admitted to hospitals for definitive care".

> "So the measure is quite easy. it is legislative. It says we must measure P1 life threatening incidents, it defines them and it says it is 15 seconds and in the definition it says when that 15 second starts and when that 15 seconds stops. So around that hard measure upon which against we report that's quite clear."
>
> **— Manager#6**

As illustrated in the above quote, one of the respondent stressed the importance of implementing and adhering to the legislations defined by the Government. As a result, the legal framework in which WCEMS operated created constraints that placed limitations on the influence WCEMS may have had on their environment. An important structural mechanism thus observed can be said to be *external environmental pressure*. External environmental pressure emanated from multiple sources, particularly the government which set out a regulatory framework for EMS. The standard performance requirement levels are necessary for WCEMS organisation to meet accreditations standards to ensure quality improvements levels defined by the government and other local and international regulatory bodies. Regulatory frameworks and standards played a fundamental role in shaping performance. The quote below from a senior manager illustrate this well.

> "Performance is how we get assessed. At the moment, the problem is that the way we get assessed is not necessarily reflective of the services we provide. If you look at our main indicators. We look at priority 1 response, under 15 minutes for priority 1 in urban areas and under 40 minutes in rural areas and there are a few other indicators that talk around that. Those two are the main ones that we get judged according to. The single most important is our priority 1 urban response rate, however, if you look at the work we do, that is the least amount of the work we do is responding to priority 1 calls in urban areas. We respond far more to priority 2 calls, we do far more inter-hospital patient transfers but we do not get measured on that., As a consequence of this pressure, you gear your services rightly or wrongly to achieve the targets that you are measured on. Not necessarily the targets you should be measured on."

— Senior Manager#2

These institutional mandates both enabled and constrained the overall operations of WCEMS in that they defined the performance management structures that WCEMS followed. IT ensured reinforcement of rules or sanctions and the formation of an institutionalized moral imperative. For example, IT allowed the control of behaviour of agents through the systematized arrangements of norms.

> One of the way the process could change is, the governance framework in which operate. It becomes more onerous if it needs more paper work. If it needs more checks. So the auditor comes in and wants to see what our performance is, and says but you don't measure this, you don't capture this or you need to fill in these forms all of which impact on our ability to do better.
>
> **— Manager#6**

In the WCEMS case, this was done through an electronic/computerised process of tracking and monitoring of individual actions and performance of agents. As a result, IT usage shaped actions and behaviours of agents and ensured they conformed to the rules and regulations. Agents risked facing potential disciplinary consequences if they did not conform.

> "It (the IT system) has also given the agents more accountability, the reason for that is because ambulance paramedics are being tracked with the automated application, whereas in the past they could take the longest route to the hospital for instance, they could take about 40 minutes to get to the hospital, now with the Automated vehicles tracking, AVL, we can see that they've taken the longest route to the hospital and can face disciplinary action from their various district managers."
>
> **— Training manager**

As shown in the the quote above, a further structure observed is related to internal of pressure coming from potential disciplinary action. Pressure from potential disciplinary action can be considered an internal structural mechanism because the IT system provided managers an affordance to track in real time what was happening both on the ground and in terms of performance outcomes.

7.5.7 Normative institutions of performance management

The analysis showed that organisational culture within WCEMS was largely dictated by the institutional rules and regulations defined by the Western Cape government of health. Managers enforced these rules and values on employees. These values became rooted within WCEMS and subsequently became the organisational culture. As such, a performance oriented culture was observed to impact on organisational performance.

> "... I've got a program that I use. It's called 'NICE'. It records all telephone conversations call-takers have with the callers. It gives me the updates. So every day for every worker that gets assigned to a specific board, everything they do is recorded. I get the recordings. So what I want to tell you is, to enforce a performance-oriented discipline, I monitor the quality of the calls. I listen to random calls in the morning. Just randomly, listen to how they nurture people. Did they sound? did they sound asleep?, did they slack down at certain time of the evening? you know things like that."
>
> **— Quality Assurance Manager**

Through the monitoring of performance and actions of agents, IT transmitted a set of norms that not only enabled but also shaped the expected actions, values and practices of agents in the delivery of EMS. Therefore, the use of IT to support the processes of EMS delivery, in its self represented a normative legitimacy.

> Agents know that they're supposed to work as a team but they still worry about their individual performance and also the the staff performance measuring system (SPMS), still plays a big role. So if you do not meet your KPIs you will not get your 13th cheque. And that is the biggest drive for the people, and I think that should also be relooked at. If we have an equal performance based system, then I think that our service will be much, much better.
>
> **— Manager#3**

As illustrated in the quote above, some agents cared more about their individual performance rather than the performance of their teams. Team work was highly

emphasised by management, however, some agents ignored the managers calls for team work. Some agents believed that their individual performance counted more than the performance of the team. As was found in the analysis, there were three different levels of culture in WCEMS. These three levels of culture observed within WCEMS played an important role in influencing IT-enabled organisational performance.

These subcultures emerged as a result of employees modifying the organisational wide values, and redefining their own assumptions within the boundary of their job level or functions. This was mainly a result of the diversity of people that were employed, the language, personal values. These subcultures that emerged at different levels impacted on employees attitudes on both individual and group towards performance as well as the use of technology.

> ... And then also there's attitudes towards technology. If the staff decide that they don't want it for whatever reason, then you know, that could impact on performance and that is changeable. So initially they're really excited about it. Do all these things really great. And then someone gets attacked for poor performance or it happens once or twice where the technology fails them their attitude changed towards technology, which ultimately in turn changes their ability to perform better.
>
> **— Manager#2**

7.5.8 Cultural-cognitive institutions

Understanding the mechanisms/factors that lead to IT-enabled organisational performance outcomes depends upon a deeper understanding of the contextual environmental conditions (Wynn & Williams, 2012). Firstly, the EMS environment was characterised by scarce resources, a high level of unpredictability of emergency demand and constant environmental changes.

In the WCEMS case, individual performance monitoring was seen as an important tool in the quest to manage and improve performance of the entire organisation. Previously, the individual performance monitoring tool was not built into the Computer Aided Dispatching system. When the new tool was introduced, agents began to focus more on improving performance which enhanced

the overall organisational performance. The monitoring tools allowed elimination of waste and because agents became aware of their individual performance they began to act more in accordance to the rules in order to avoid any disciplinary measures.

> Besides the culture change, it has also brought in change with the operations staff as well as the communication staff, because now they know they are being watched, they've being measured on performance, attitudes and their willingness to adapt and that's been a real change for the health and wellness team of EMS.
>
> **— Training coordinator**

Classification of WCEMS organisational culture

The definition of culture adopted in this study is one given by (Schein, 1985, p. 17), who defines organisational culture as a "pattern of shared basic assumptions that was learned by a group as it solved its problem of external adaptation and internal integration; and that has worked well enough to be considered valid, and therefore to be taught to new members as the correct way to perceive, think, and feel in relation to those problems".

It was observed that in the WCEMS organisation, there was no prevailing single organisational culture. Instead, there were multiple sub-cultures at different levels of the organisation. These sub-culture types held different sets of belief systems, attitudes, assumptions and values towards performance. Thus, following Schein (1996) taxonomy for classifying organisational cultures, it was observed that the organisational culture within WCEMS was divided into three distinctive organisational subculture types.

1) The 'managers' subculture : illustrated by the senior managers, and supervisors. These were the first people to be held accountable for poor organisational performance outcomes.

2) The 'agents' subculture : embodied by the call taker and dispatcher staff of WCEMS who receive and dispatch the emergency medical call cases incoming into the center. These cared more about their individual than collective performance statistical reports.

3) The 'operation crew' subculture : embodied by the emergency medical paramedics who are directly involved on the front line with the sick or injured patients.

7.6 Identification of candidate mechanisms

The empirical findings obtained up to this point support the proposal of several mechanisms that provide potential explanations for organisational performance outcomes underpinned by IT in resource constrained EMS organisations. In the WCEMS case, findings were consistent with the main constructs of the two theoretical frameworks used to observe the phenomenon. The identification of the key findings provided both, a suitable reasoning and categorization of the different antecedents. In addition mechanisms and conditions of IT-enabled organisational performance as well as explanations of the factors that influenced the performance outcomes were observed.

As a result of abductive reasoning, six candidate mechanisms are proposed: (1) IT infrastructures services; (2) Performance-oriented organisational culture; (3) Efficiency of business processes; (4) IT-enabled resource optimisation (5) Real-Time performance analytics and (6) Organisational learning. Appendix C provides a detailed illustration of the abductive process for the analysis of these proposed mechanisms.

for example particular kinds of organisations may be liable to have particular MIS implementation problems".

Given that critical realist explanation building is fundamentally an epistemic process of discovery (Wright & Bechtel, 2007), the discussion following next, presents the reasoning behind the proposed mechanisms. The interactions between underlying structure and mechanisms on different levels involves a dynamic process of which their effects enable attainment of organisational performance outcomes. These are discussed below in detail.

7.6.1 Proposed mechanism 1: IT infrastructure services

IT infrastructures were observed to influence all the business processes of emergency delivery services. This is because end-to-end management of emergency

services depended on the processing and management of information. Efficient and effective provision of emergency services as well as attainment of organisational objectives would have been impossible without adequate IT infrastructure services. This was evident when senior management recognised the importance by substantially investing in IT infrastructure that underpinned all primary business processes.

Analysis of organisational documents revealed that IT infrastructure services presented the most significant structure which provided a stable platform for all business processes and operations for WCEMS. These IT services enabled WCEMS to: (1) maintain key business processes such as call taking and ambulance dispatching, real time performance management and reporting; (2) Share information across departments which allowed managers to explore opportunities for collaboration across business units; (3) to have more control of key resources more fleets of vehicles, shift/roaster management; (4) business continuity and (5) better management of applications services.

> The IT infrastructure underlies everything we do here. Ok, from ICT Point of view. So that's your framework essentially this includes for example, your connectivity infrastructure which would include an NPLS cloud, which includes your you know things like your mobile operators. You know the 3G connectivity, in there is satellite, provided by external providers. ... then there is the mobile infrastructure. Which is essentially what's the fixed infrastructure in a vehicle (ambulance) if you can call it that. It allows use to track things like your Mobile Data Terminals, Patient Data terminals ... And then there's the applications which include the Computer Aided Dispatch system. which includes rostering and fleet management. basically those. Those are the main ones. Even though there's a lot of overlap because healthnet will include mobile data terminals one has its own kind of specific workflow.
>
> **— ICT Manager#1**

IT infrastructure consists of multiple dimensions relevant to the enabling of organisational performance (Melville et al., 2004a). This is because, IT infrastructure services have largely been associated with the ability of organisations to

effectively adapt to changes in the environment effectively (Broadbent, Weill, & St. Clair, 1999; Byrd & Turner, 2001; Weill, Subramani, & Broadbent, 2002).

> "... basically we permanently monitoring our infrastructure services. We have various stakeholders that are our service providers, we make sure that all the latest updates are done on time, so that we get the best out our infrastructure services, because if you don't constantly monitor your infrastructure, then the machines, servers and all other services are going to get sluggish and that's going to affect productivity"
>
> **— ICT Manager#1**

As illustrated in the above quote, the managers understood the importance of the IT infrastructure and made sure that they kept monitoring to make sure that all services were running as expected. Moverover, WCEM's IT infrastructure contained important characteristics that enabled the implementation and provided IT services such as databases, networking, security, virtualisation and end-user applications underpinned by business processes.

7.6.2 Proposed mechanism 2: Performance-oriented organisational culture

Organisational culture within WCEMS was changed by the CAD system. This was done through the processes that were encoded in the IT applications such as individual performance tracking. These made sure employees remained focused on attaining achieving individual performance as well as group performance.

> "...When we do not have enough human resources for call taking, then everybody jumps in to help where they can, especially when the queue of calls waiting is too long, or when we get twice the amount of calls ..."
>
> **— Supervisor#1**

In the above quote it is evident how interactively the different agents work together in order to achieve a common goal. Collaboration ensures that they improvise on the human resource shortage experienced by WCEMS. Such interactions and collaborations between the different agents were necessary in WCEMS and appears to have been embedded in the organisational culture.

> "In this organisation, or in the government we have the Staff Performance Measuring System (SPMS). It's only done once a year. The chances of getting it is very slim . People have to work hard in order to qualify for a bonus. I am currently working on something. I have assessed a few calls and have identified the excellent performers and the not so good performers, and the really bad performers. I can identify who they are already."
>
> **— Quality Assurance analyst#1**

> " ... the SPMS, still plays a big role. So if you do not meet your KPIs you will not get your 13th cheque."
>
> **— Manager#3**

As can be seen in the above quotes, an important stimulating mechanisms observed is that of Staff Performance Management System (staff incentives). The monitoring of staff performance and actions of agents was considered a stimulating mechanism. It not only enabled but also shaped the expected actions, values and practices of agents in relation to their individual performance. In addition, it contributed towards the performance of the entire organisation.

7.6.3 Proposed mechanism 3: Efficiency of business processes

The introduction of a new CAD system was done parallel to the reengineering of some inefficient business processes with the aim of improving flow of resources and improved execution of work tasks. Likewise, re-engineering of business processes allowed managers to holistically and radically redesign performance

improvement interventions that enabled WCEMS to move towards achieving efficiency of business processes.

> We saw it with the initial rollout is although the system had far more capabilities and far more functionality than the old one, the user although trained on how to use it still resorted on a set of business processes that were more suited to the old solution than the new solution. So even though people you know could do so much more with it they then they just defaulted to old ways. So when we look at it and say did we re-engineer our processes pure.
>
> **— Manager#4**

As illustrated in the quote above, the influence of efficient business processes on organisational performance was primarily characterised by a reciprocal relationship between IT and business processes. In other words, IT supported the business processes, and conversely, the business processes were driven by IT. In particular the core business process activities were defined based of the IT infrastructures services of WCEMS. One of the biggest drivers for EMS practices improvement changes has been the need for greater accountability and efficiency in emergency medical service delivery. This need has manifested itself through the re-engineering of key processes and the modernization of IT services.

> "... The main reason was to first get the correct resource to the correct incident in the shortest possible time, to improve performance and to improve patient care. The ultimate goal was to improve patient care. So we wanted the right ambulance with the right equipment sent to the right patient."
>
> **— Manager#4**

As shown in the above evidence from the interview data, the main analysis can be summarised as: a strong commitment to the attainment of organisational goals and objectives (i.e provision of quality healthcare and performance improvement), allowed WCEMS to continuously seek to improve their business processes. This was manifested in the investment and procurement of IT

services which supported organisational functions, such as the new CAD system. This resulted in an improvement in communication amongst staff members throughout the organisation.

Optimising the processes alleviated the pressures associated with maintaining a high response time which potentially inhibited agents' abilities to make appropriate decisions for the particular cases.

> Getting the right decisions happening more frequently to the best possible performance measure and then say Well I think the processes are tune.
>
> **— Manager#4**

7.6.4 Proposed mechanism 4: IT-enabled resource optimisation

Interview data, and participant observations revealed that managers placed an emphasis on the organisational mission (i.e to provide quality emergency services and to improve organisational performance outcomes). This was made possible through various resource visualisation mechanisms embedded in the CAD system. Specifically, the CAD system allowed supervisors and managers to have a holistic view of resources, enabling them to make better decisions regarding optimisation of resources for better use.

> "... We reshuffle and try to equalise the shift. Based on the amount of people we have according to the language Afrikaans and Xhosa. Use overtime, change hours according to the peaks. Say we get 200 calls that come into the center from 12 to half past 6 in the evening, so we won't use 12 hour shifts ..."
>
> **— Supervisor#1**

As illustrated by the quote above, managers systematically organised WCEMS resources and organisational business processes to optimise the already scarce resources.

> "... Because it's unpredictable how those calls would come in, you have to prepare for the worst. Ideally the way we approach that is that we want to be able to do most of the functions from one center, but because of the geographic distances, dispatching of ambulances is difficult ..."
>
> **— Manager#1**

As shown in the above quote, managers realised that with the resource constraints facing WCEMS, they had very little options but to use the resources that was already available at their disposal. They opted to use IT to find the resources that were not being utilised efficiently, and devised strategies to optimise these resources.

Consequently, IT played an important role in enabling optimisation of resources to send the correct resources to the appropriate incident. This, in turn, helped to reduce wasted time and resources caused by sending ambulances to incidents where they were unable to assist the patients. The communication manager emphasised the necessity of matching the correct resources to the correct patients/incidents.

> "...There's no point in sending a junior crew to a mass Motor vehicle casualty. But that wouldn't suffice. So the system allows us to see what's available or what the limitations and the levels are. then form there, we send the most appropriate."
>
> **— Coms Manager#1**

Furthermore, the implementation of the advanced vehicle tracking system as well as intelligent dispatch and scheduling resulted an increase in efficiency in the usage of resources during peak activity.

> "...If you take for example, Eden and Karoo. Now to run the Karoo center, you need atleast 10 staff plus one manager. For Eden, because it's busier, you require at least 20 staff plus 1 supervisor and 1 manager. The problem is that their call volume is very low. They might only do about 10 calls a night, so let's say might do 30 calls in a day but you still have to staff it for those calls. And because it's unpredictable how those calls would come in,

you have to prepare for the worst."

— Manager#2

As shown in the above quote from the interview, combining patients located in the same geographical area that needed transportation to a common tertiary hospital improved efficiency. Another example is the scheduling of shifts with staff with diverse skills to complement where there was a shortage of staff. Moreover, using the CAD system, managers were able to identify resources that were underutilized, and were reassigned to alleviate the pressures of emergency demand.

As such, IT-enabled optimisation of resources can be said to be an important mechanism that enabled the attainment of the increase in productivity. Unfortunately, shortage of resources meant that managers had to frequently optimise the resources often to enable the delivery of EMS and thereby maintaining performance levels.

7.6.5 Proposed mechanism 5: Real-time performance analytics

Real time performance analytics in WCEMS involved the monitoring of the key performance indicators that defined how the organisation was functioning in relation to its resources. This enabled WCEMS managers to achieve the organisational objectives and to achieve the predefined goals set by the department of health.

" ... Because of real time reports, there are more interactions between staff and supervisors, especially in the districts managers, because now everybody is on par. Everybody gets the same reports at the same time in real time. So every body is on par as what is happening out there. Whereas, previously, they were disconnected from the staff on the road ..."

— Manager#5

With respect to real time analytics, through the integration of traditional data analysis techniques with real time intelligence. Real time analytics allowed discovery of trends which facilitated the optimisation of resources in order to improve operations. Processing and analysis of performance data helped managers to make evidence-based decisions which in turn ensured operational resilience as well as increased organisational responsiveness.

> "...From only eleven ambulances allocated to each dispatcher, you have to find ways to manage them accordingly. So when demand for emergency cases is very high, we use the CAD system to interrogate which resources are not engaged or used optimally. So, you have to reshuffle the resources around to accommodate everyone."
>
> **— Dispatcher#3**

As shown in the quote above, dispatchers faced many challenges of managing few resources while ensuring that all P1 emergency cases were serviced accordingly. Therefore, through real time reports, emergency dispatchers were able to access reports of where ambulances were positioned in geographical areas that had very few or no major emergency cases and reassigned them to the busiest of geographical areas.

Furthermore, through the use of CAD system, senior managers were able to interrogate the system further to determine the number of available ambulances with the necessary equipment that could be dispatched to multiple patients with similar injuries. This way, the number of unattended emergency cases was reduced and in the process boosting overall organisational performance. In sum, optimising resources use is considered an important functional mechanism that directly impacted productivity and enable improved levels of performance outcomes.

Maximizing and optimising organisational performance was considered an essential requirement for delivering emergency services and improving response times. Managers devised various performance improvement initiatives, and these were introduced to improve emergency response times.

These included, effective measurement and analysis of individual performance in real-time, as well as, the introduction of digital performance display boards

for both call-takers and dispatchers. The introduction of digital performance display boards allowed for transparency and facilitated effective communication and coordination between call-takers and dispatchers.

> " ...The performance monitoring tool has given them more accountability, the reason for that is because agents know now that they are being tracked with an automated application ... whereas in the past they could take the longest route to the hospital for instance, they could take about 40 minutes to get to the hospital, now with the Automated vehicles tracking, AVL, we can see that they've taken the longest route to the hospital and address it with their various district managers."
>
> **— Manager#2**

As shown in the quote above, performance was monitored in real time using a number of dedicated IT services and tools. The real-time performance monitoring system was responsible for monitoring, reporting (using advanced visualization reports) both individual performance and aggregated team performance for the entire organisation.

The visualization of real time performance by teams allowed team members to work together by adapting their team members' scheduled activities and to assist struggling team members. This in turn enabled a more collaborative working environment. The real time performance reports displayed on the digital display boards were considered an important affordance that created a reference point which managers and supervisors made use of to plan, discuss and develop strategies for predicted high demands of emergency services (e.g. weekends of month ends). Finally, the mechanism of real time performance management allowed for better management of priorities, routines, and work tasks.

7.6.6 Proposed mechanism 6: Organisational learning

Interviews with participants indicated that agents tended to refer back to previous events of similar characteristics and the different actions that were taken to deal with previous cases and on that basis, they were able to take appropriate action for new cases.

> "... We have over the years realised that Mondays tend to be abit busier, and it peaks from 14:00 onwards, with the amount of incoming calls, because the clinics close at 16:00. So, the facilities (clinics) would start calling in requesting for ambulances to transport patients. So, when that happens and when we do not to have enough human resources for call taking, then everybody jumps in to help where they can, especially when the queue of calls waiting is too long, or when we get twice the amount of calls."
>
> **— Supervisor#2**

From the above quote, two important mechanisms playing out can be identified. These are organisational learning and performance-oriented culture in the organisation. First, the respondent indicated that over time, they've identified the busiest days of the week which is Mondays. This implies organisational learning. As a consequence, they tend to organise their resources in order to deal with the anticipated busiest day of the week. As such, organisational learning was mainly a by-product of the actions which were most often based on previous experiences, and concentrated primarily on the improvement of existing performance outcomes. Learning was observed through the actions of individuals and team/groups (dispatchers and call-takers) in their reactions to various types of events that manifested at different levels of the organisation. As a result, organisational learning was identified in the analysis of the data as a potential mechanism for maintaining and improving performance.

Organisational learning mechanism was also triggered by the ability of agents to learn from previous experiences. In the WCEMS case, learning was observed in various instances, triggering adaptation to the WCEMS environment. To maintain learning, managers emphasised the need to capture, store and refer to previous experiences from extreme cases at the individual level, group/team and organisational learning level. They assessed how activities and processes at one level would effect on other levels.

> "... What we've also done is, we've aligned the operation hours for certain crews and certain divisions, to make sure they work back to back and that is just to cover the shortfall felt during the day, especially, when we have a shift handover at night and we have an x number of crews that are running through the day to cover those shortfalls ... "
>
> **— Supervisor#1**

As illustrated in the above quote, through organisational learning, managers studied the trends and patterns of emergency demands and were able to manage their resources according to these patterns and trends. For WCEMS, adequate knowledge management resources and knowledge sharing practices are considered integral powers that made organisational learning possible in the pursuit of desired performance outcomes.

7.7 Chapter summary

This chapter presented the analysis of the data that was collected from the case. Given that the healthcare industry is a complex industry in which institutionalisations of IT in work practices are common (Davidson & Chismar, 2007), CAS and institutional theory provided theoretically resilient sources for investigating the mechanisms of IT-enabled organisational performance which are influenced by technological, cultural and structural forces, as well as, external environmental dynamics. Abduction/theoretical redescription were applied to identify and analyse the candidate mechanisms of IT-enabled organisational performance in the case.The findings were presented in light of two theoretical lenses; the Complex adaptive systems and Institutional theory. In Chapter 8 to follow, step 4 to step 6 of the Bygstad et al. (2016) framework for data analysis are applied to further analyse and discuss the generative mechanisms identified in this Chapter.

In Chapter 8 to follow, a discussion and implications of the findings as well as the research model are presented.

Chapter 8

Findings and discussion

8.1 Introduction

This chapter presents the findings and discussion. The previous chapter focused on the first objective, that is, *To determine the underlying structures and mechanisms associated with IT-enabled organisational performance in the context of resource-constrained EMS organisations*. This chapter mainly focuses on the second and third objectives which are: *To explain how the identified mechanisms work* and *To identify and explain the contextual conditions in which the identified mechanisms are activated*.

The chapter is structured as follows: Section 8.2 to follow, presents retroduction which is step 4 of the Bygstad et al. (2016) critical realist analysis framework. Following that, section 8.3 presents the analysis of candidate mechanisms, while section 8.4 assesses the explanatory power of the mechanisms identified. Section 8.5 discusses the theoretical elaboration and implications of the generative mechanisms identified. This section also discusses the issues concerning the nature of the relationship between the mechanisms and IT-enabled organisational performance. Thereafter, section 8.6 discusses the contextual conditions in which the mechanisms are activated. Next, section 8.7 presents the research model while section 8.8 presents a comparison with other theories with respect to the findings. Section 8.9 concludes the chapter with a summary and review of the entire chapter.

8.2 Step 4. Retroduction

In the third step of critical realist data analysis framework of Bygstad et al. (2016), the main empirical findings of the case were identified and analysed through the lenses of CAS and institutional theory. Qualitative content analysis was employed in order to abduce the generative mechanisms that give rise to the outcomes. Logically, retroduction is the fourth step which follows abduction/theoretical re-description.

Retroduction is a method of analysis that enables the researcher to ascertain the necessary conditions without which something cannot exist. Essentially, retroduction allows for identification of the fundamental prerequisites of social interactions, rationality, experience, and human action. Sayer (2010, p.104) notes that "to ask for the cause of something is to ask what *'makes it happen'*, what *'produces'*, *'generates'*, *'creates* or *'determines'* it, or ... , what *'enables'* or *'leads to'* it". However, to assert that a particular mechanism causes an outcome, (and not any other), methodologically, it is therefore important to clearly define and specify the powers and liabilities possessed by the identified mechanisms. Mechanisms possess powers, which may or may not be triggered (Danermark et al., 2001). Even when these 'powers' are exercised, they may not necessarily manifest in the observed events due to some other counterbalancing powers of other generative mechanisms. Easton (2010) notes that mechanisms may also possess liabilities. These liabilities are often the susceptibility of mechanisms to perform a particular action or set of actions. As such, for each mechanism identified, the powers and liabilities are discussed in the subsequent sections.

8.2.1 Mechanism 1: IT-infrastructure services

In essence, fundamental processes and activities necessary for the delivery of quality emergency services were highly coordinated and standardised and were primarily underpinned by the IT infrastructure. IT was therefore considered more than just a tool for automating business processes. To understand the powers and liabilities of IT infrastructure services within WCEMS several documents were analysed in combination with interviews. These documents described the IT initiatives undertaken by WCEMS during its IT transformation period between the years 2010 to 2014.

A number of documents were found relating to different aspects of WCEMS' IT policies, the implementation of new systems, and wide-ranging assessments of their IT infrastructure capabilities. However, there were a number of inhibitors. These included enduring concerns about systems updates and upgrades that affected the CAD system, which intermittently slowed down the business processes. Furthermore, the link between ambulance vehicles in the field depended on third-party mobile telecommunication infrastructure which was not always reliable. Loss of connectivity affected performance when ambulances could not receive data from the communication centre in areas that had low or no LTE/3G connectivity.

8.2.2 Mechanism 2: Performance-oriented organisational culture

Two aspects of culture were identified which played an important role in influencing performance outcomes in WCEMS. These are (1) cultural reinvention and (2) behavioural compliance. According to Wankhade and Brinkman (2014), cultural reinvention refers to the representation of espoused attitudes and behaviours that on the surface may appear new and yet upon closer inspection these attitudes and behaviours are simply continued adherence to old culture camouflaged as new. Behavioural compliance refers to the desire by top management to realise a long-term change in culture through changed values and beliefs. However, these values remained unchanged. Individual performance for call-takers was measured against the total number of emergency cases processed, in particular, the number of Priority 1 (P1) cases. For dispatchers, individual performance was measured against the number of P1 cases dispatched under 2 minutes. Aggregate scores were calculated per incident from when the call was accepted to when the ambulance reached the patient.

8.2.3 Mechanism 3: Efficiency of internal business processes

Improving the efficiency of business processes was operationalised through the implementation of the CAD system to manage and control communication and information management. The use of the CAD system necessitated re-engineering of processes to improve the efficiency of operations. A key motivation behind

re-engineering of processes was an improvement of resource management and to improve decision-making as well as improvement of performance.

Ultimately, the goal was to get the right resources (paramedics, ambulances, and equipment) to the right patients at the right time. The new CAD system was a catalyst in this respect. The optimising resources allowed elimination of wasted time through agents becoming aware of their performance. Therefore, they began to act more by the rules to avoid any disciplinary measures taken against them. For example, a functionality was introduced that changed the process of call capturing. This was called "partial registration" whereby call takers were required to capture call information in the CAD system within a maximum time of two minutes. Several challenges were encountered when maintaining and improving business processes. Some of the inhibitors to the efficiency of business processes that were observed included the ability to implement changes to existing business processes without disrupting daily business operations. Additional inhibitors included an overwhelming number of enhancement and change requests as well as the implementation of new workflows that corresponded to the implementation of change requests and enhancements to IT systems.

Several challenges were encountered when maintaining and improving business processes. Some of the inhibitors to efficiency of business processes that were observed include the ability to implement changes to existing business processes without disrupting daily business operations. Additional inhibitors include an overwhelming number of enhancements and change requests as well as the implementation of new work flows that corresponded to the implementation of change requests and enhancements to IT systems.

8.2.4 Mechanism 4: IT-enabled Resource optimisation

Due to the high demand for EMS in the Western Cape province achieving a high percentage response rate of emergency incidents was considered an important priority to the success of WCEMS mission. As discussed, an important performance mechanism in the context of resource constrained organisations is the creative use or optimisation of resources.

> "... Availability of staff with the following competencies is limited: Nursing in specific speciality areas such as: emergency care, theatre and intensive care, advanced psychiatry, advanced midwifery and paediatrics; Family physicians specifically speciality areas within the rural areas; Radiographers in speciality areas (ultrasound, oncology and nuclear medicine); Engineering technicians; Forensic pathology officers; and Emergency care technicians and paramedics."
>
> **— WCEMS Annual report (2015)**

Since the analysis of the data focused on explaining the causes of performance, the resources of interest are categorised into two groups: First is the human resources (call takers, dispatchers, ambulance paramedics, emergency doctors, supervisors and managers). Secondly, the material resources (ambulances, equipment, staff). It follows from the data analysis that in order to achieve organisational performance, WCMES needed to optimise the limited resource available to ensure maximum utilisation and to eliminate waste.

8.2.5 Mechanism 5: Real time performance analytics

The introduction of a real time vehicle tracking system made it easier for managers to improve resource allocations based on emergency demands from different locations in the Province. By tracking all ambulances, managers were able to combine emergency case dispatch whenever it was deemed necessary. In addition, the CAD system helped managers to optimise the resources by intelligently dispatching ambulances and rescheduling shifts.

> "Real time reports have affected performance in the sense that ... we currently more aware and know exactly where the problem areas are which allows us to take some actions when necessary."
>
> **— Manager#5**

As illustrated by the above quote, real time analytics is therefore considered an important mechanism for actualising improved performance outcomes.

With respect to *real time performance analytics*, tracking of organisational performance was considered an essential requirement for delivering emergency services and improving response times. Several performance improvement initiatives were introduced in an attempt to improve response times. These included effective measurement and analysis of individual performance in real time, as well as the introduction of digital performance display boards for both call takers and dispatchers. The introduction of digital performance display boards that projected real-time KPIs allowed for transparency and facilitated a more effective communication and coordination between call takers and dispatchers. Through the real time monitoring of performance, managers were afforded the necessary information about when, where as well as how performance of the entire organisation was unfolding in real time. This was particularly beneficial for the optimization of resources given that resources (ambulances) that were not in use by some dispatch boards, were immediately transferred or reassigned to the dispatching boards that needed them the most.

8.2.6 Mechanism 6: Organisational learning

Pérez-López et al. (2005) define organisational learning as a dynamic process of creation, acquisition and integration of knowledge aimed at the development of resources and capabilities that contribute to better organisational performance". Duncan (1979, p.84) define organisational learning as "the process within the organization by which knowledge about action-outcome relationships and the effect of the environment on these relationships is developed". The concept of organisational learning is considered in literature as an important mechanism of performance improvement through enhanced knowledge management and better decision making (Fiol & Lyles, 1985; Huber, 1991).

From an organization-wide perspective, real-time management of performance gave rise to the mechanism of organisational learning. This was realised through trend analysis of historical data of previous dispatch and emergency cases. For example, managers and supervisors were able to analyse previous trends of emergency cases, and time periods, (e.g. there was high demand of emergency services at the end of the month in the townships when people get paid). Although demand for emergency services remained unpredictable, through trend analysis managers learnt to plan to provision critical resources in geographical

areas that were most likely going to be affected. As such, data from data warehouses on emergency cases were analysed and converted into information with a high degree of accuracy and integrity, which became the basis for decision making within WCEMS. This enabled managers to assess how best to deal with unexpected disturbances from the environment. Several observations revealed that through a culture of knowledge sharing of lessons learned, corrective actions were promoted amongst individuals and team members. The cycle of organisational learning continued when managers integrated minor changes in daily operations to improve business processes.

8.3 Step 5. Analysis of the set of mechanisms

Based on the Bygstad et al. (2016) critical realist data analysis stepwise framework, theoretical *redescription/abduction* and *retroduction* techniques were followed to propose mechanisms that link potential mechanisms with concrete outcomes. On the basis of abductive and retroductive modes of inference conducted in this chapter, it makes sense to conclude the generative mechanisms that give rise to IT-enabled organisational performance. The underlying generative mechanisms proposed in this study can be broken down into two types; structural mechanisms, and coordination mechanisms. Table 8.1 provides a summary of the proposed mechanisms. However, it is not sufficient to simply discuss and define the mechanisms with their causal propensities; it is also necessary to be able to assess and discuss the explanatory power of the identified mechanisms function in light of other theories.

8.3.1 Structural mechanism: IT infrastructure services

Information technology infrastructures are perceived as fundamental enablers of organisational performance (Bharadwaj, 2000). According to Weill et al. (2002, p.57), IT infrastructures are "a collection of reliable, centrally coordinated services budgeted by senior managers and comprising both technical and human capability".

TABLE 8.1: Proposed generative mechanisms mapped to the different levels

Elements of the research model		Concepts	Relevant CR domain		
			Real	Actual	Empirical
Generative mechanisms	Structural Mechanisms	IT infrastructure services	×	×	
		Performance oriented Organisational culture		×	
	Coordination Mechanisms	Efficiency of internal business processes	×	×	
		IT-enabled Resource optimization	×	×	
		Real time performance analytics		×	
		Organisational learning	×		
	Contextual conditions	1. Low Performance outcomes & Low Resource availability 2. Low Performance outcomes & High resource availability 3. High performance outcomes & Low resource availability 4. High performance outcomes & High resource availability	×	×	×
Outcomes		IT-enabled performance outcomes			×

There is a significant body of literature regarding the increasingly important role of IT infrastructure services in enabling organisational performance in healthcare organisations (Armstrong & Sambamurthy, 1999; Lee & Choi, 2003). However, the challenge still persists on how to effectively evaluate the direct contributions of IT to the attainment of organisational performance objectives (Melville et al., 2004a). Given that IT infrastructures have become integral part of the structure and processes of organisations (Kumar, 2004), the contribution of IT infrastructures in EMS organisations cannot be considered in isolation.

8.3.1.1 Causal tendencies

Information technology capabilities are perceived as fundamental enablers of organisational performance (Bharadwaj, 2000; OuYang, 2017). IT infrastructure capabilities consist of multiple dimensions considered relevant to the enabling of organisational performance. This is because, IT infrastructure services have largely been associated with capability to facilitate organisations to effectively

adapt to changes in the environment (Broadbent et al., 1999; Byrd & Turner, 2001).

IT infrastructure services were considered a significant role player in ensuring that WCEMS maintained the quality compliance levels as well as to meet their performance targets.

> "... Well obviously it's the western government health department, they are the ones funding a program. there's a number IT service providers. The hospitals, how they play their role they see the patients. So they have the patient information and patient data, on hand, before they actually get to the hospital which helps alot because it gives them some time to prep for when the patient is coming in. But that's more or less in terms of the technology side."
>
> **— Manager#6**

8.3.1.2 Enabling conditions

In the WCEMS case, IT infrastructure capabilities provided a platform that allowed for the establishment of information management standards and integration of business processes. This ensured consistency in the management as well as dissemination of information through out the WCEMS organisation. As a result, the collected data was analysed and converted into information with a high degree of accuracy and integrity became the basis of decision making in the organisation.

Further analysis of organisational documents revealed that the IT infrastructure services which underpinned business processes was fundamental and provided a resilient infrastructure for delivering fast and efficient emergency services.

Figure 8.1 illustrates a layered IT infrastructure configuration that acted as the backbone to WCEMS business processes and operations. There were three primary layers that were underpinned by the IT infrastructure. These were resource management layer, control center management layer and information management layer.

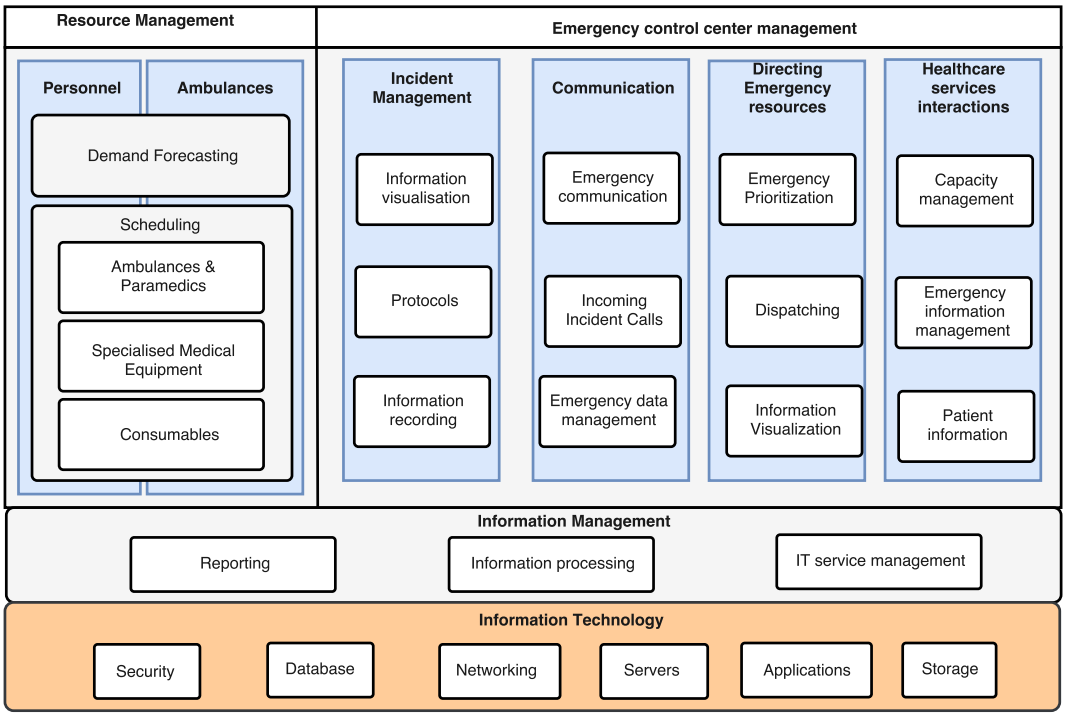

FIGURE 8.1: IT infrastructure services (Adapted from: WCEMS)

In addition, the identified powers and liabilities were enacted to varying degrees at different points throughout WCEMS operations. It was observed that in conditions of high demands of emergency services, the integrated information management platform allowed managers and supervisors to formulate response strategies that allowed the WCEMS organisation to respond to the changing demands of emergency services adaptively. This resulted in improved organisational agility and incremental improvements in performance.

Figure 8.2 illustrates how the mechanism of IT-infrastructure acts as a foundation for IT use in WCEMS and how it works in context. There are three important structures that interact. These are (a) Information management, (b) Resource management and (c) Information Technology. As was previously demonstrated in Figure 8.1 the enabling conditions and causal tendencies of resource communication, incident management, directing emergency services and health service interactions give rise to the mechanism of IT infrastructure services which feedbacks to reinforce the three structures.

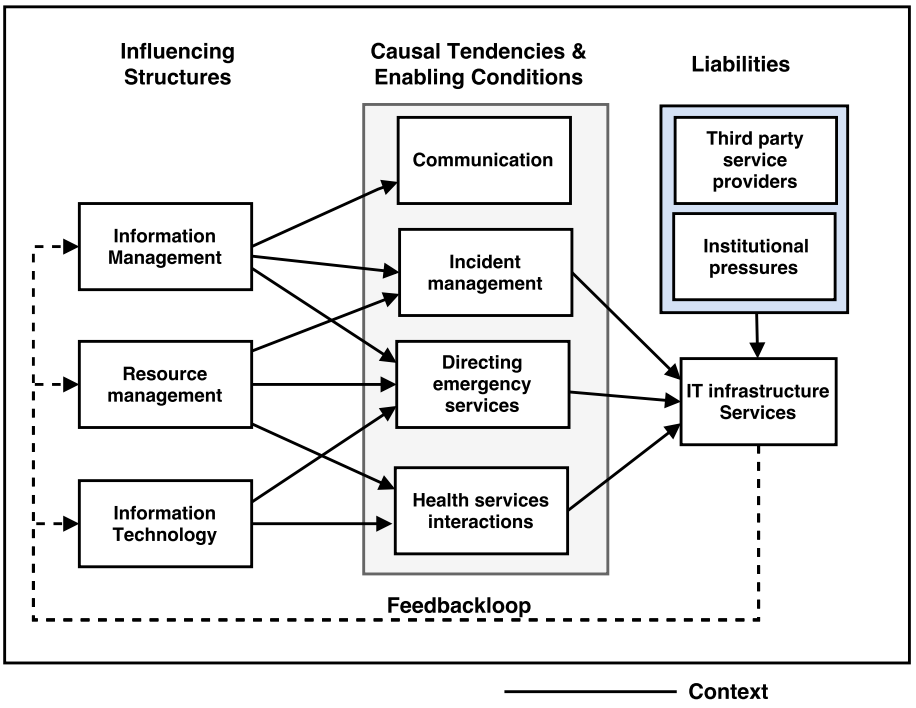

FIGURE 8.2: IT infrastructure services mechanism

8.3.2 Structural mechanism: Performance-oriented organisational culture

8.3.2.1 Causal tendencies

Previously, agents were oblivious of the effect of individual performance on the team. After being made aware by management that individual performance impacts on overall team performance, agents devised their own creative methods of using the systems to suit their work tasks, thereby changing or modifying the predetermined rules set out by management. As a result, a new sub culture of practices developed between the actors on how to get the most out of the CAD IT system in order to improve their team performance. The dimension of individual performance versus group performance can be said to be the extent to which individual actors understand the effect of their individual performance on the group. Triandis (1995) argue that "individualistic cultures emphasize rationality, rights and contracts, individual decision making and accountability, and place the goals of the individual over those of the group".

Findings from early studies on organisational culture have argued that culture

can be used as a mechanism to improve performance in organisations (Marcoulides & Heck, 1993; Saffold, 1988). Examples of these studies include research by Terrence and Allen (1988) and Ouchi (1981). More recent studies focusing on the causal link between performance and culture concur with this relationship (Cheung, Wong, & Wu, 2011).

The main argument presented in these studies is that culture can be manipulated. This happens through control and management in order to yield desired performance objectives. According to Hofstede, Neuijen, Ohayv, and Sanders (1990) symbols, rituals and heroes are cultural manifestations in an organisation. These cultural manifestations are revealed by work practices espoused within an organisation (Hofstede, 2011).

Nevertheless, Hofstede et al. (1990, 2001) suggests that 'value' is a much "deep manifestation of culture" (Hofstede, 1998). Schein (2004) proposed a typology of properties to describe culture. These are, shared meanings group norms, espoused values, formal rituals and celebrations, root metaphors, as well as observed behavioural irregularities. Furthermore, Schein divides these properties into three distinct levels of cultural manifestations. The first category is the 'artefacts', followed by 'espoused values and beliefs', and thirdly 'underlying assumptions'. In a different study, Rousseau (1990), further developed Schein's model by including two more layers: 'behavioural norms' and 'patterns of behaviour'.

8.3.2.2 Enabling conditions

There are two important enabling conditions to performance-oriented organisational culture. These are behavioural compliance and cultural reinvention.

Behavioural compliance

Multiple instances of behavioural compliance were observed in WCEMS. The conceptualisation of Behavioural compliance in this study is consistent with Ogbonna and Wilkinson (1990), who argue that "many culture interventions fail

in their objective of value change but do influence the behaviours of organisational members". As a result of the newly adopted CAD system, WCEMS reengineered their business processes and developed new strategies for improving performance.

These strategies' espoused values were mainly performance oriented (e.g., emphasis on quality services, efficiency and effectiveness of emergency delivery). In addition, these espoused values corresponded to a number of government regulations and emergency services acts (Ifinedo, 2014). At face value, managers and supervisors had hoped for behavioural compliance from the part of emergency paramedics, call takers and dispatchers. However, some employees still struggled to comply with the regulations and had somewhat negative attitudes toward change.

Cultural reinvention

Cultural reinvention manifested within WCEMS after the introduction of the new CAD system. The new system had a significant impact on business processes and operations. The change necessitated a cultural reinvention. However, as was shown in the analysis of the data, employees still held on to previous 'ways' of working in silos as opposed to working in teams.

The espousal of new team-oriented modes of operations had led to some misunderstandings and ambiguity regarding individual versus group performance. Some employees believed that their individual performance statics were more important than group performance. This ambiguity led to the triggering of cultural reinvention.

Figure 8.3 illustrates how the mechanism of Performance oriented organisational culture works in context. Essentially, there are two important mechanisms that interact. These are (a) IT infrastructure services, (b) organisational learning. As was discussed above in this section, the two enabling conditions of behavioural compliance and cultural reinvention interact with the influencing mechanisms to give rise to the mechanism of Performance oriented culture.

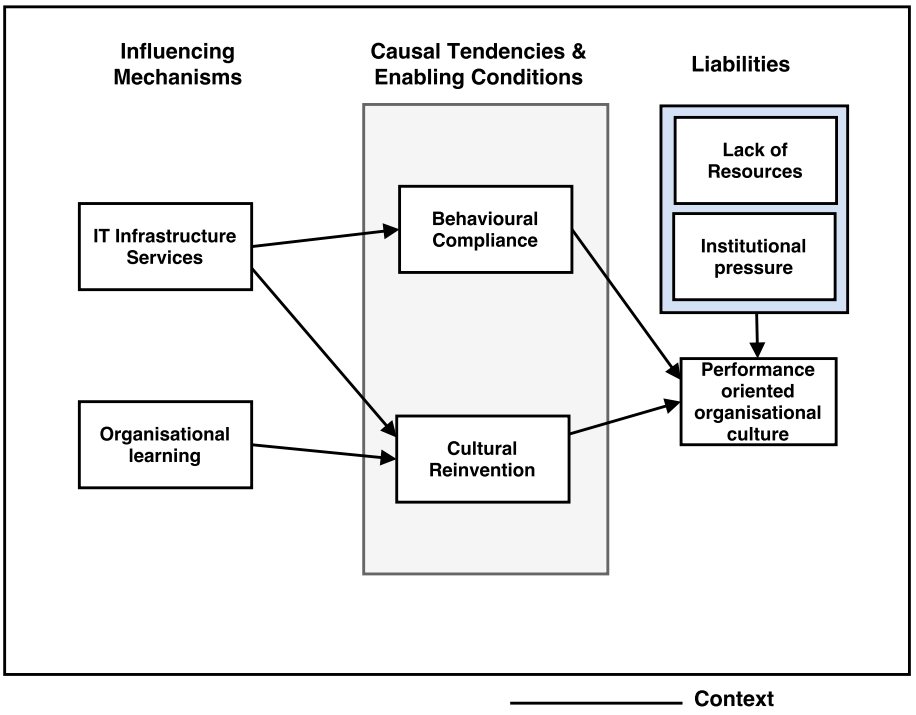

FIGURE 8.3: Performance oriented organisational culture mechanism

8.3.3 Coordination mechanism: Efficiency of internal business processes

8.3.3.1 Causal tendencies

IT-enabled business processes formed the foundation for delineating the modalities in which emergency services were delivered. In this light, key activities such as call taking and dispatching which were driven by IT, were organised according to a process-oriented principle. As was seen earlier in the analysis of interactions, the introduction of the mobile data terminals into all the ambulances across the Western Cape Province enabled easier dispatch of emergency cases.

The change of processes and MDTs improved the interactions between agents. With MDTs, emergency dispatch personnel could dispatch emergency cases by a simple "drag and drop" and the data would appear in real-time on the mobile data terminals inside ambulances in the field. These new processes reduced previous errors caused by the loss of data as a result of inefficient radio communications between the emergency centre and the ambulances.

Given that the new CAD system offered additional features in terms of managing resources, the goal was to develop performance reports that enabled easy management of performance in various conditions (peak vs off peak). Organisational performance was expected to temporarily suffer as a result of migration to the new system. As the new CAD system was being widely accepted and used by various users (e.g. call-takers, dispatchers and supervisors), senior level management quickly realised the need to improve performance. WCEMS managers redesigned their performance processes and reports to incorporate the KPIs as well as to meet the mandate set by the WCDoH, (both provincially and nationally). A new performance management system was subsequently introduced after the introduction of the CAD system. The performance system afforded managers a comprehensive view of performance for the entire organisation and to conduct analyses and draw different types of performance reports.

8.3.3.2 Enabling conditions

It has been established in literature that organisational processes play a critical role in maintaining and facilitating the delivery of medical emergencies (Poulymenopoulou, Malamateniou, & Vassilacopoulos, 2003). From an emergency response perspective, WCEMS' fundamental processes such as call-tasking, ambulance dispatching, documentation, information processing, reporting were performed in an organised and structured manner. Considering that WCEMS' operational environment was characterised by unpredictable and volatile conditions, the efficiency of these fundamental processes played a significant role in establishing stability, effectiveness and consistent functioning of WCMES. A fundamental set of activities and factors which enabled efficiency of business processes in the WCEMS can be summarized as: (a) establishment of performance standards guided by response-time definitions, (b) real time performance management, (c) optimization of resources, (d) adaptation to environmental dynamism and (e) managerial decision-making. Prior dispatching of an ambulance, the processes of emergency response involved the collection of, and rapid organisation of data points provided by the emergency caller for fast and efficient decision making.

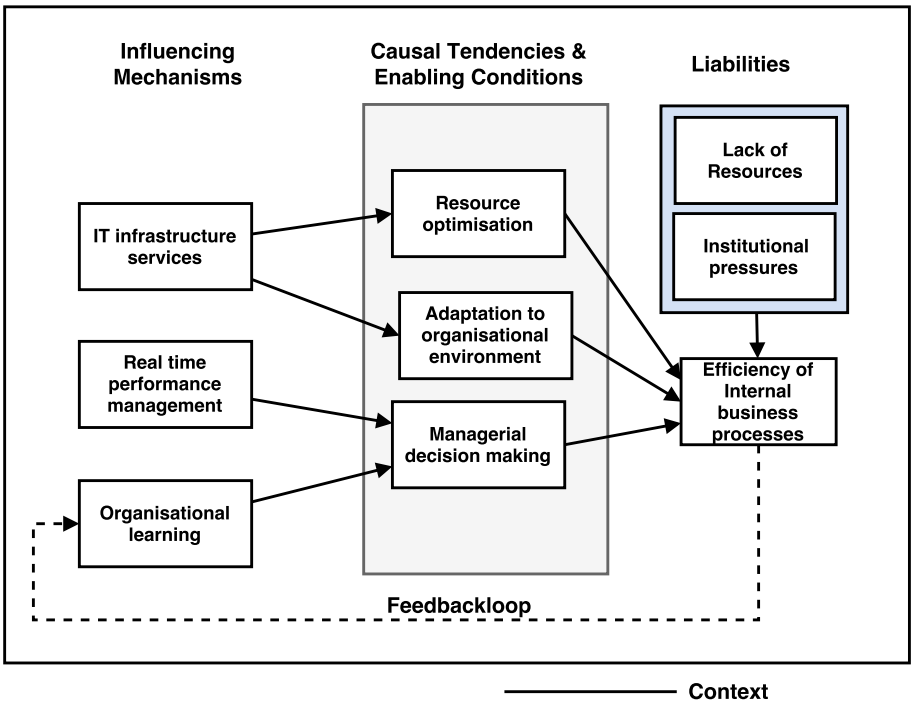

FIGURE 8.4: Efficiency of internal business processes mechanism

Figure 8.4 illustrates how the mechanism of Efficiency of internal business processes works in context. This mechanism in influenced by three important mechanism. These are (a) IT-infrastructure services, (b) organisational learning and (c)Real time performance analytics. Together with the enabling conditions and causal tendencies of resource optimisation, managerial decision making and the adaptation to the environment, give rise to the mechanism of Efficiency of internal business processes. This mechanism in turn feeds back to reinforce the mechanism of organisational learning.

8.3.4 Coordination mechanism: IT-enabled Resource optimisation

8.3.4.1 Causal tendencies

The CAD system used at WCEMS allowed identification of resources that were available, and the determination of how the resources were being utilised. This allowed experienced senior managers to interrogate the resources and to devise strategies that enabled the creative use and optimisation of these resources. The environment in which WCEMS operated was largely characterised by high

scarcity of different types of resources (e.g. human, ambulances). The resources were often already exhausted or stretched as a result of the non-linear, highly unpredictable demands of emergency services. To manage the highly unpredictable service demands effectively, managers used the CAD system to assist them with coordinating the service demands. The CAD system quickly and efficiently processes information for decision-making to alleviate pressure on the existing resource capacity of WCEMS. The increase in productivity measured according to the increase in the amount of emergency calls attended to per annum, have had positive effects on performance outcomes for WCEMS which was part of WCEMS' growth strategy. For WCEMS, one of the main strategies of obtaining more resources was to carefully manage their existing resources through optimised use. IT helped to interrogate how the available resources could have been used in a more efficient and effective manner.

8.3.4.2 Enabling conditions

Considering the obvious challenges of lack of resources and funding constraints, managers were left without any options but to work with the available resources. There were a number of factors and functional mechanisms that triggered the optimisation of resources. Through use of real-time reports, managers were able to interrogate how the available resources (e.g. available ambulances and staff) could be optimised in order to make the best dispatching decisions.

Other factors such as skills specialisation and lean practices as well as lean principles embedded in the CAD system ensured that no time was wasted by agents performing extraneous work tasks. Key processes and activities of emergency response involved high specialisation of work tasks and were performed by highly specialised people. For example, call-tasking and dispatching, EMS response paramedics, supervisory roles and managerial roles. The high specialisation of functions in the WCEMS, facilitated greater learning curves and dedicated skills development practices. As a result, the high specialisation of business processes activated preplanned routine actions by agents. Optimisation of resources enabled the increase in productivity and directly affected operations and ultimately an increased in performance levels. As a result, there was immediate improvement in productivity which positively impacted performance.

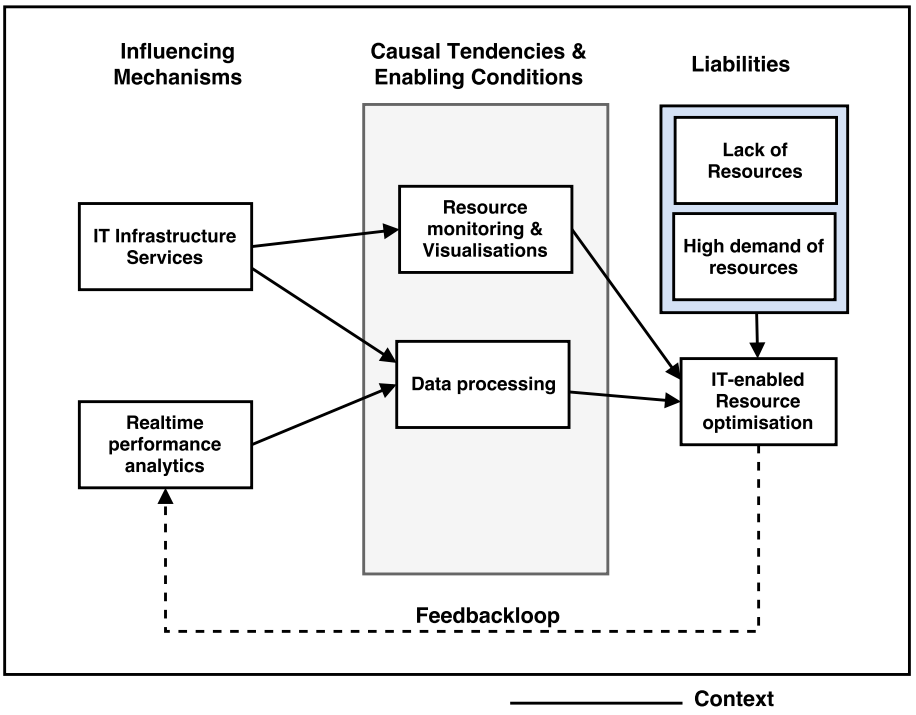

FIGURE 8.5: IT-enabled Resource optimisation mechanism

Figure 8.5 illustrates how the mechanism of IT-enabled Resource optimisation mechanism works in context. This mechanism in influenced by two important mechanism. These are (a) IT-infrastructure services, (b) real time performance analytics. Furthermore, there are two important enabling conditions and causal tendencies, of which together with the influencing mechanisms give rise to the mechanism of IT-enabled resource optimisation. Without the IT infrastructure, it would be impossible to have the mechanism of IT-enabled resource optimisation. The real time performance analytics allow to visualise and monitor in real time performance levels. In the end, this creates a feedback between the optimised processes and the real time performance monitoring.

8.3.5 Coordination mechanism: Real time performance analytics

8.3.5.1 Causal tendencies

The real-time performance monitoring system was utilised for monitoring reporting performance by means of using advanced visualisation reports of both

individual performance and the aggregated performance of the entire organisation. Performance and actions monitoring norms embedded in the CAD system constituted a legitimation system that guided the behaviour and actions of agents as well as promoted appropriate decision-making for particular emergency situations. As a result, emergency responses were improved, shared meanings cultivated, and collaboration protocols standardised.

8.3.5.2 Enabling conditions

Performance metrics were monitored in real time using dedicated IT services and tools. A resilient IT infrastructure services was integral to the enablement of real time performance analytics.

Prior to the introduction of real time performance reports, a great deal of management time was wasted on staying abreast of the situation at the emergency control centre using historical data from a data warehouse in order to make decisions on events that had already occurred. Consequently, coordination of resources was poor. After the implementation of the real time reports, the ability to visualise real time performance on the digital display boards allowed the supervisors and managers to take immediate remedial action to strengthen areas that were not performing according to the expected standards. Thus, IT infrastructure provided a platform which managed complex data processing applications, advanced data warehouse and database applications. A combination of these IT services made it possible to provide real time analytics of data about emergency cases.

Figure 8.6 illustrates how the mechanism of real time performance analytics works in context. This mechanism in influenced by three important mechanism. These are (a) IT-infrastructure services, (b) organisational learning and (c) IT-enabled Resource optimisation. Along side the enabling conditions and causal tendencies of visualisation systems that allow to visualise the performance in real time, the vehicle tracking system, data processing and real time performance reports together they give rise to the mechanism of Real time performance analytics which in turn feedback to reinforce the mechanism of organisational learning and resource optimisation.

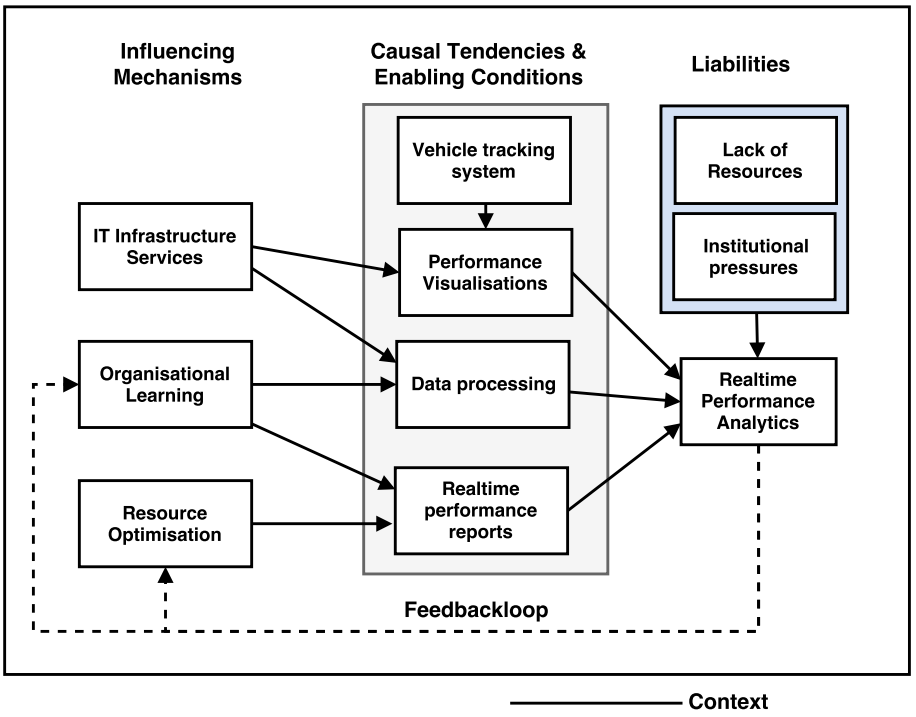

FIGURE 8.6: Real-time performance analytics

8.3.6 Coordination mechanism: Organisational learning

8.3.6.1 Causal tendencies

Organisational learning in WCEMS was mainly the consequence of multiple relationships and interactions between agents and structures (rules, regulations). These interactions were intended to produce combined efforts between actors (managers, supervisors, dispatchers, call takers and emergency paramedics) to achieve the common goal of providing fast and effective emergency services. Organisational learning was facilitated by, but also reinforced by the culture of knowledge sharing which was integral to emergency service delivery. Knowledge acquisition and information sharing made it possible to maintain organisational learning while promoting more interactions between human actors which in turn reinforced the culture and practices of learning.

8.3.6.2 Enabling conditions

This further suggest that organisational learning is an important mechanism that can help to enable performance in EMS organisation.

When learning mechanisms were triggered, individuals agents, teams or organisations learned through accumulated knowledge by reacting adaptively to changes in the environment and thereby improving performance. Huber (1991, p. 89) argues that an entity learns "if, through its processing of information, the range of its potential behaviours is changed". For WCEMS, the learning mechanism was triggered by the performance analytics mechanisms which in turn triggered resource optimisation mechanisms and resulted in improvement in performance levels based on prior experiences. These findings are consistent with those of Avgerou (2001), Panagiotidis and Edwards (2001) and Andreu and Ciborra (1996). Furthermore, Nafei (2015) after studying the link between organisational performance and organisational learning, found a close relationship between organisational learning and organisational performance. This further suggests that organisational learning is an important mechanism that can help to enable performance in EMS organisations.

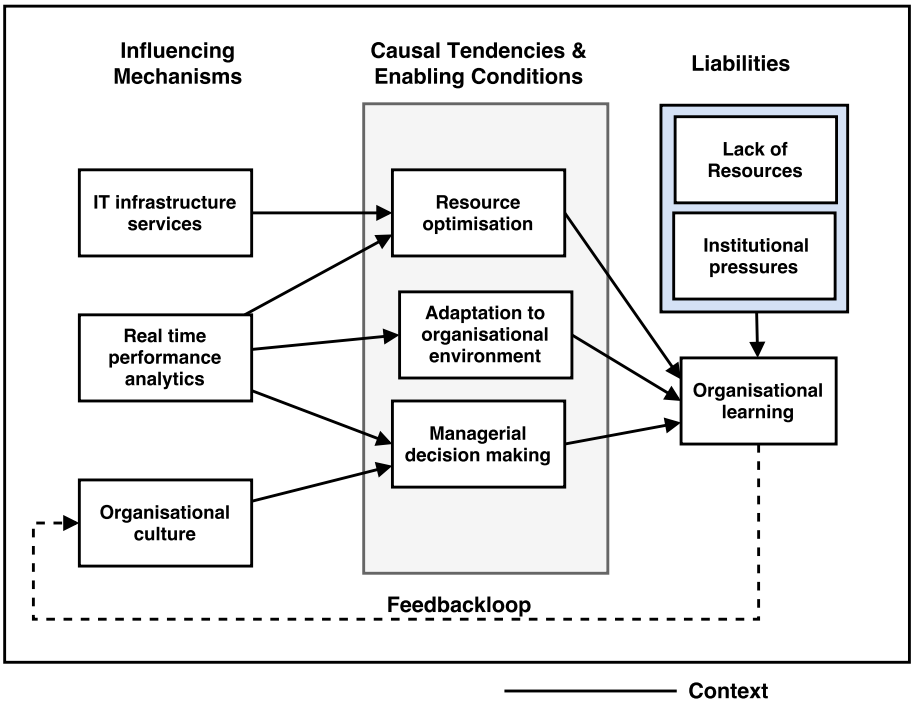

FIGURE 8.7: Organisational Learning mechanism

Figure 8.7 illustrates how the mechanism of organisational learning works in context. There are three important mechanisms that interact. These are (a) IT infrastructure services, (b) Real time performance analytics and (c) Organisational culture. Together with the enabling conditions and causal tendencies of

resource optimisation, adaptation to environment and managerial decision making, give rise to the mechanism of Organisational learning which feedbacks to reinforce organisational culture (of high performance).

8.4 Step 6: Assessment of explanatory power of mechanisms

The assessment of the explanatory power of the generative mechanisms is based on the analysis of the data presented in both Chapters 7 and 8. The findings proposed a combination of a set of generative mechanisms with their corresponding powers and liabilities as well as contextual factors that influence organisational performance in resource constrained EMS organisations. A deeper understanding of the underlying mechanisms and their interactions as well as their effects is essential for critical realist based explanations. The different events and key entities that influenced organisational performance as described in step 1 and 2 (see section 7.3 and 7.4) of the critical realist data analysis framework in the previous chapter highlight the important relationship between the underlying structures and mechanisms of IT usage and organisational performance. It was evident that IT significantly governed the interactions between the human agents. It is plausible to argue that IT plays an important role in terms of facilitating communication between agents.

Moreover, agents are considered active participants in shaping social structures that are produced by human agency. Critical realism maintains the separation of actor's actions from social structures as different entities, as a result, "they may neither collapse nor conflate into each other" (Sayer, 2000 p.18). While there is substantial evidence in the literature that IT-use actually influences organisational performance (Devaraj & Kohli, 2003; Melville et al., 2004a; Santhanam & Hartono, 2003), institutional structures from the organisational environment have also been recognised as imperative in the actual usage of IT (Arndt & Bigelow, 2000; Lewis, Agarwal, & Sambamurthy, 2003; Raymond, Paré, & Bergeron, 1995).

The underlying mechanisms of resource optimisation and real time performance analytics through the IT infrastructure services led to the concrete outcome of performance improvements.

Furthermore, through a performance oriented culture and organisational learning mechanisms, efficiency of business processes was actualised by human agents (IT users). This in turn led to improved organisational productivity without increasing resources.

Recent organisational studies have viewed organisational culture as an important factor that influences organisational performance (Acar & Acar, 2014; Jacobs et al., 2013; Marcoulides & Heck, 1993). Scholars argue that to achieve improvement, organisational structural changes are insufficient on their own. Morrill (2008, p. 16), notes that the "emergence of organisational culture frameworks that emphasised organisations as systems of meanings and symbols' has been an important contribution to the discipline".

Literature on organisational learning has shown that there are four important dimensions to learning in organisations. These four stages were observed in WCEMS throughout the different cycles of emergency service delivery. These phases or dimensions are: First is the Knowledge acquisition phase. This phase or dimension was manifested by the acquisition of incident information from the environment and acquisition of information from internal sources (e.g., information on the availability of resources) which allowed managers and supervisors to perform constant situational analyses. Secondly, the distribution and sharing of knowledge between different actors, (managers, supervisors, dispatchers and call-takers).

Thirdly, the interpretation of this knowledge followed logically from knowledge sharing, which allowed different actors to incorporate their personal experiences and existing knowledge regarding certain situations of events, and such personal experiences were mostly different between individuals. In so doing, this allowed to attain a common understanding, fostered cooperation and co-ordination between individuals. Fourth and finally, organisational memory. The objective of this phase was to collect and store knowledge for use in the future. The technology (data warehouse, knowledge management system) in place made it possible to store knowledge but also allowed individuals to collect and store tacit knowledge in the form of procedures and knowledge sharing sessions. This finding supported by previous studies, such as Ruiz-Mercader, MeroñO-Cerdan, and Sabater-SáNchez (2006), and Tippins and Sohi (2003) who argue for the importance of creation of learning environments in order to improve organisational performance outcomes.

The respondents described how the goal of improved productivity through the ability to offer faster response afforded by the combination of structural and coordination mechanisms was achieved.

> "I have assessed a few calls and have identified the excellent performers and the not so good performers, and the really bad performers. I can identify who they are already."
>
> **— Quality Assurance analyst#1**

> " ... Now with the Automated vehicles tracking, AVL, we can see that paramedics on the road have taken the longest route to the hospital and can face disciplinary action from their various district managers."
>
> **— Training manager**

Concerning "efficiency of business processes", WCEMS undertook to re-engineer core business processes to implement critical changes that were necessary as a result of the implementation of the CAD system. Core processes such as call taking and dispatching were re-engineered with the goal of making WCEMS processes more efficient.

One of the main reasons for re-engineering of processes was the recognition that existing processes were contributing to a lag in performance outcomes due to the inefficiencies that were built around the previous CAD system. This meant that there was a need to find ways to make existing processes more efficient by accelerating key processes through the elimination of wasted time. This would, in turn, reduce resources required to attend to emergency cases and grant emergency paramedics more time to reach the emergency scene within 15 minutes as required by the WCDoH.

8.5 Theoretical elaboration and implications of generative mechanisms

The development of explanations through mechanisms using the Bygstad et al (2016) critical realist data analysis framework have proposed that IT-enabled

organisational performance in WCEMS was mainly driven by six mechanisms. These are (1) IT-infrastructure services, (2) Performance-oriented organisational culture, (3) Efficiency of internal business processes, (4) IT-enabled resource optimisation, (5) Real-time performance analytics and (6) Organisational learning.

From the perspective of emergency service delivery, the empirical findings in the previous chapter were consistent with findings from previous studies. For example, Gil-Garcia and Pardo (2005); highlight the importance of alignment between governing policies and IT usage for organisational practices. The analysis showed that emergency healthcare activities in WCEMS were guided by a number of governing policies (structures), which in turn influenced IT-use and in the process had enduring effects on how IT was used to facilitate emergency delivery.

For each mechanism, a number of properties (i.e. the causal tendencies, enabling conditions, powers and liabilities) of that mechanism, as well as the interactions with other mechanisms, actually produced the IT-enabled performance outcomes experienced by WCEMS. However, without knowledge of these properties, it would have been difficult to understand that the performance outcomes would not have been produced by the particular set of generative mechanisms that were at play in the case. The lack of knowledge about the properties of these mechanisms would mean that the way in which the six mechanisms were activated and the performance outcomes produced would have been difficult to understand in totality.

One important requirement for the provision of high quality emergency services and meeting performance targets was the need to have adequate resource capacity. The resources, as previously discussed in Chapter 6, included material, human and knowledge resources. As such, the structure and responsiveness of the EMS environment within which WCEMS was situated had a significant impact on the quality of emergency services provided to the public. Indeed, one of the respondents made it clear that, in the Government's view, the ongoing shortage of resources was one the biggest constraint on enhancing the performance of WCEMS. In order to address this problem, WCEMS managers set out an impressive agenda for modernizing their IT services and to better utilise Information technologies. As a result, this helped to increase performance levels. Furthermore, WCEMS attempted to achieve their performance targets through a number of mechanisms, including, incentive systems; optimising their business

processes for efficiency and inculcating a culture of high performance throughout the organisation.

8.6 Contextual conditions

The environment plays a significant role in controlling the availability of resources and the capacity with which organisations can perform their activities. Based on the findings, it is possible to assert that organisational processes are inhibited by resource constraints, institutional structures as well as uncertainties emanating from the EMS environment. These three can be said to constitute the causal characteristics of the EMS environment. Hence, the proposed mechanisms allow to illuminate the relationships between the usage of IT and organisational performance outcomes. These relationships are made possible by several mechanisms that may support managerial decision-making, inform policy and promote sustainability in resource constrained contexts.

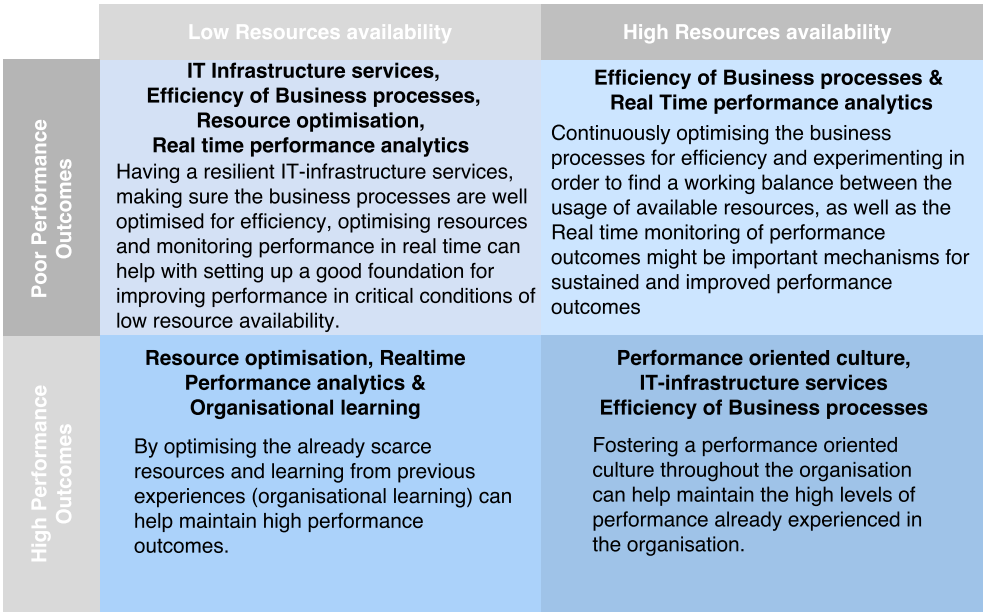

FIGURE 8.8: Contextual conditions

Four primary contextual conditions were identified. These are: (1) Poor performance outcomes with low resources availability; (2) Poor performance outcomes with high resource availability; (3) High performance outcomes with low resources availability and (4) High performance outcomes with high resource

availability. Figure 8.8 illustrates the four contextual conditions that exist with the corresponding mechanisms that fit the respective contextual conditions.

8.6.1 Poor performance outcomes with low resource availability

In critical conditions of poor performance outcomes with low resource availability, four mechanisms can set up a foundation for improving performance outcomes. These mechanisms are (1) IT Infrastructure services, (2) Efficiency of Business processes, (3) Resource optimisation, (4)Real time performance analytics. Having a resilient IT-infrastructure services and making sure the business processes are well optimised for efficiency as well as optimising resources and monitoring performance in real time can act as a long-term mechanisms for sustainability and consistent desired performance improvements.

8.6.2 Poor performance outcomes with high resource availability

Conversely, in conditions of poor performance outcomes with high resource availability, two mechanisms are essential for improving performance outcomes. These are : (1) Efficiency of business processes and Real Time performance analytics. Continuously optimising business processes for efficiency and experimenting in order to find a working balance between the usage of available resources as well as the Real time monitoring of performance outcomes might be important mechanisms for sustained and improved performance outcomes.

The need to continuously improve on organisational performance can drive managers to initiate programmes geared towards experimentation by optimising certain processes, and to hold meetings to evaluate the processes that are working, when, how and why. This can allow managers to develop a set of possible alternatives actions for processes that are not working well in conditions of poor performanc outcomes with high resource availability.

8.6.3 High performance outcomes with low resources availability

Conditions of high performance outcomes with low resources availability are the ideal conditions most EMS organisations should be aiming for. The challenge is the sustainability of such ideal conditions. Three mechanisms can help maintain these ideal conditions. These are: (1) Resource optimisation, (2)Real-time Performance analytics and (3) Organisational learning. By continuously optimising the already scarce resources and monitoring performance with analytics in real time as well as learning from previous experiences (organisational learning) can help maintain and sustain such ideal conditions of high performance outcomes with low resource availability.

8.6.4 High performance outcomes with high resources availability

Conditions of high performance outcomes with high resources availability can be difficult for EMS organisations in developing countries to find themselves in. Considering that most EMS organisations have an inherent problem of resource capacity, these conditions would be rare to achieve. Nevertheless, fostering a performance oriented culture throughout the organisation can help maintain the high levels of performance already experienced in the organisation (Bélanger, Cefaratti, Carte, & Markham, 2014). These conditions assume a strong and resilient IT infrastructure, efficient business processes and other mechanisms to be already in place to maintain high levels of performance.

8.7 Consolidated research model

The proposed IT enabled-mechanisms highlight the important role played by IT in supporting delivery of EMS in contexts of resource constrained EMS organisations. The relationship between the underlying structures and mechanisms can be said to be specified by an organised set of functional mechanisms that produce organisational outcomes as their effect. Hence, the concept of

emergent and adaptive organisational performance that was not limited to pre-planned representation of agents or performance management structures. Instead, agents were afforded the flexibility to be resourceful, innovative and to engage in their own acts of performance management at the individual level.

Meanwhile, from a CR perspective, mechanisms do not specify what outcomes will be produced in future, because there is a set of counter mechanisms, also known as dysfunctional mechanisms that may prevent the functional mechanisms from producing their outcomes. This again means that organisational performance was not linear but inherently dynamic. Yet, in order to achieve desired performance outcomes, dysfunctional mechanisms should be suppressed in order to improve productivity and produce improved response time performance (Yang, Tong, & Teo, 2015). It would appear that dysfunctional mechanism such as lack of adequate resources, negatively influence on organisational performance.

The model developed in this study describes the relationship between the underlying mechanisms and IT-enabled organisational performance. The model also depicts how both structural and coordination mechanisms explain IT-enabled organisational performance as an on-going process involving continuous interactions from the abstract to the concrete to the extensive. As shown in the model in Figure 8.9, there is a continuous process of how both structural and coordination mechanisms are moderated by contextual conditions over time.

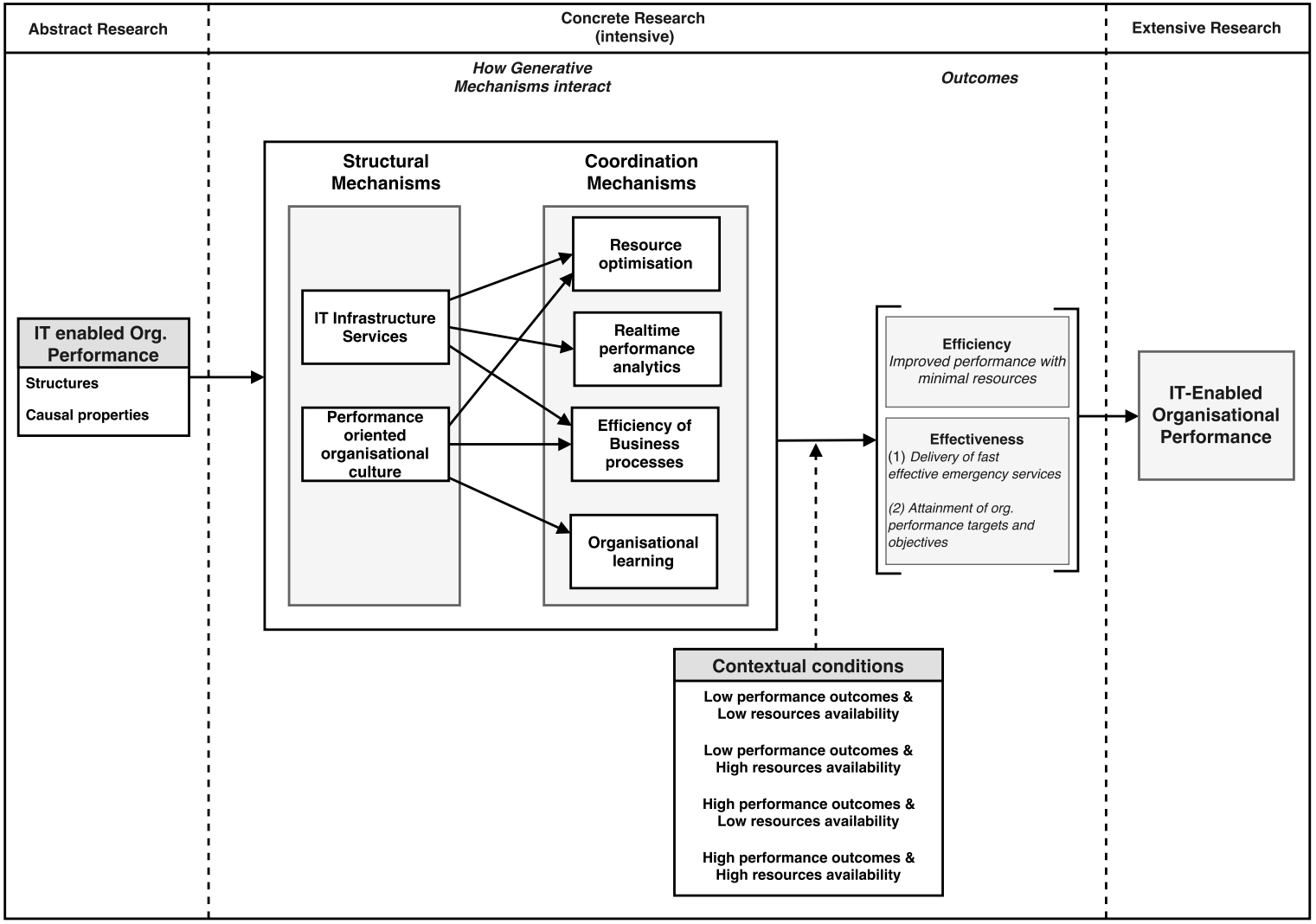

FIGURE 8.9: Research model

The structural mechanisms account for how mechanisms such as IT-infrastructure services and performance-oriented organisational culture influence IT-usage actions and managerial decision-making. The coordination mechanisms denote how mechanisms such as IT enabled resource optimisation influence IT usage for emergency delivery. Together the structural and coordination mechanisms interact but are also moderated by contextual conditions. The interaction process develops over time, allowing for changes over time and explaining changes in performance outcomes which are measured in terms of KPIs and are represented in terms of efficiency or effectiveness of emergency medical service delivery. Thus, the framework allows for various cycles of interactions between both structural and coordination mechanisms that unfold over time and occur in the context of resource constrained environments.

8.8 Comparison with other theories

During the review of the literature as well as the analysis of the case, the study interrogated how other theories conceptualised IT-enabled performance from different perspectives. This resulted in a myriad of literature on organisational performance.

Comparison with other theories makes it possible to compare and contrast the findings in this study with other findings by relevant researchers. By so doing, it makes is possible to connect early organisation performance literature which was mostly about improving efficiency and effectiveness with newer perspectives and approaches such critical realist assumptions and open systems. The previous chapter developed from this analysis as well as the review of the literature regarding the dominant perspectives of both IT and organisational performance. This revealed multiple perspectives that contribute to IT-enabled organisational performance in EMS organisations. Existing theories with particular focus on organisations and their environments reviewed in Chapters 2 and 4 are based on diverse underlying assumptions. For instance, the systems theory considers organisations as systems of interdependent activities embedded in and dependent on wider environments (Bjorck, 2004; Scott, 1987). Institutional theory argues that ideas, beliefs, and assumptions about institutions and organisations are created and reinforced by a wide range of actors and forces (Currie, 2009).

The resource dependence theory (RDT) argues that organisations interact with their environments by exchanging resources in order to survive. Hence, while it was difficult to identify the mechanisms underpin IT-enabled organisational performance, it was nevertheless also clear that the phenomenon could not have been fully explained from a single theoretical perspective. Therefore, from the empirical evidence discussed thus far in relation to generative mechanisms ascertained from the WCEMS case, it is therefore necessary to further contrast the theoretical perspectives discussed in literature on IT and organisational performance. Given the resource constrained EMS context this study is situated, special attention is directed to two theoretical perspectives, that is IT and organisational performance in healthcare context. Table 8.2 illustrates a comparison of the different elements of the research model and how they compare to the different theories.

Advocates of the Resource Based View believe that there is a strong relationship between organisations having resources and firm performance (Coff, 1999; Newbert, 2007; Wade & Hulland, 2004). However, with respect to organisational performance in public sector organisations (e.g., Public healthcare organisations), resources may increase the organisation's capacity to attain certain KPIs and, which ultimately, contribute to organisational performance (Goel, Rehm, & Junglas, 2017). Moreover, availability of resources may be used to alleviate pressures associated with delivery of emergency services which most EMS organisations constantly struggle to keep up with. For instance, in the case of WCEMS, managers' constantly lobbied with stakeholders to prompt the government to provide more resources in terms of ambulances with the right equipment (eg. advanced life support capabilities) that would have enabled WCEMS to deal with high demands of emergency services in peak conditions. With very minimal resource available, the optimisation of the available resources, though being an important mechanism, was only effective to certain degrees.

According to the Resource Dependence Theory (RDT), organisations are open systems. This means that organisations are highly dependent on their environments to acquire resources and ensure survival (Pfeffer, 2010; Pfeffer & Salancik, 2003). Furthermore, according to early works by Pfeffer and Salancik, (2003) "organisations' principal goal is to maintain access to critical resources in order to ensure survival". However, the resources are entangled in a "complex network of interdependencies and varying levels of power, giving rise to uncertainty as

Table 8.2: Comparison with different theories

Elements of the research model	Mechanisms	Relevant Theories				
		Resource based view	Institutional theory	Resource Dependence Theory	CAS theory	Time Critical Info. Services
Structural mechanism	IT infrastructure services		×		×	
	Performance oriented-organisational culture		×		×	
Coordination mechanisms	IT-enabled resource optimisation	×	×	×	×	
	Organisational learning		×	×	×	×
	Efficiency of internal business processes	×	×	×	×	×
	Real time performance analytics		×		×	×

to a firm's ability to maintain access to critical resources" (Bendickson, Gur, & Taylor, 2016).

According to the RDT, there are three constructs that comprise resources and environmental uncertainty: These are (1) munificence, (2) dynamism, and (3) environmental complexity. Researchers suggest that, when studying organisational environment, it is impractical to investigate everything. Some environmental properties are more relevant and significant than others (cf. Osborn & Hunt, 1974). Organisational researchers have argued that it valuable to categorise organisational environment based on levels of particularity, proximity, and relevance to the organisational phenomenon of interest. As such, the analysis focused on the above three relevant environmental constructs within the EMS environment that influence how EMS organisations operate. The rationale is because, the scarcity of resources or uncertainty about the environment inspire managers to take actions that influence the organisation in securing resources as well as to reduce environmental uncertainty (Leong, Pan, Ractham, & Kaewkitipong, 2015). One of the most widely studied theories with respect to culture in organisations is the Strong Culture Theory (Denison & Mishra, 1995). According to the Strong Culture Theory, there is a symbiotic relationship between strong organisational culture and organisational performance (Saffold, 1988). According to the strong culture theory, when management and employees are committed to achieving a common goal and are fully aligned in terms of

organisational values, morals, practices and principles, this positively influences organisational outcomes (Marcoulides & Heck, 1993).

Furthermore, organisational culture scholars argue that as a result of this symbiotic relationship, high performance can yield a strong culture in an organisation (Bowen & Ostroff, 2004). This means that when an organisation constantly produces high performance results, it fosters amongst employees shared principles, purpose and values as well as common goals. It was observed as a result, this self-reinforcing mechanism between organisational performance and culture contributed to the attainment of desired organisational performance outcomes.

One of the key empirical findings in the case, was that, the institutional structures such as government pressure had a significant influence on organisational performance outcomes. These outcomes included, broadly speaking, the improved performance through the provision of effective and efficient as well as quality EMS with limited or constrained resources. Yet, the dominance of external actors (such as stakeholders and government) in commanding and influencing critical resources in an organisation plays an important role (Lyytinen & Grover, 2017).

However, resource optimisation is not a construct well explained by the RDT considering that the environment plays a key role in influencing organisations internal decisions. In contrast to the ecological theory, Hannan and Freeman, (1989) applied the ecological theory to explain organisational structure through adaptation to the environment. The ecological theory argues that specific social environments produce distinctive organisational processes and structures, and according to Hannan and Freeman (1989) these distinctive processes and structures that particular to healthcare organisations produce specific types of outcomes. The ecological theory does not oppose or contradict previous theories and findings. However, it maintains that there is a special relationship between specific types of organisations (eg. healthcare organisations) and their environments because of their structures and processes are distinctive.

8.9 Chapter summary

In this chapter, the findings were discussed and the research model was developed. The model presented in this chapter indicate the relationships between the structural and coordination mechanisms and how these interact in order to produce IT-enabled organisational performance outcomes. Furthermore, the model helps to identify critical mechanisms and contextual factors that should be considered in order to produce desired performance outcomes. The chapter to follow concludes the thesis by revisiting the research questions, objectives and provides a summary of the entire thesis.

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Chapter 9

Conclusion

9.1 Introduction

The aim of this study, was to investigate the underlying structures and mechanisms that give rise to IT-enabled organisational performance in resource constrained EMS organisations. The review of literature on organisational performance phenomena and IT use was discussed in Chapter 2. In addition, this provided a foundation for the study by outlining a research agenda for the study.

The philosophical approach guiding the study was presented in Chapter 3. The theoretical perspectives underpinning the study was covered in Chapter 4. In the same chapter, it was shown through the analysis of the different theoretical frameworks, that each of the theories identified were specialized in one of few types explanations. The research design and methodology were summarised in Chapter 5. The contextualization and description of the case were presented in Chapter 6. The analysis of the data were presented in Chapter 7, while the discussion of the findings was presented in Chapter 8.

This chapter therefore concludes the thesis by revisiting the research questions and reviewing how the research objectives of the study were addressed. As such, the rest of this chapter is organised as follows: Section 9.2 briefly reviews where and how the research questions were addressed in the thesis. Following that, Section 9.3 evaluates where and how the research objectives were achieved. Section 9.4 presents the findings integrates into the body knowledge as well

as the theoretical contribution. Section 9.5 presents the implications of the research. Section 9.6 presents the practical implications of the findings. Section 9.7 summarises the limitations of the study. The chapter concludes with Section 9.8, which discusses the recommendations for future research.

9.2 Revisiting the research questions

This study has been guided by the following research question:

What generative mechanisms explain IT-enabled organisational performance in resource constrained EMS organisations?

To answer the main research question, two sub-questions were asked:

SQ1: ***Why and how do the mechanisms produce the observed organisational performance outcomes in resource constrained EMS organisations?***

SQ2: ***What contextual conditions exist and how do they influence IT-enabled performance mechanisms in the attainment of organisational performance outcomes?***

In chapter 1 and chapter 3, the view of generative mechanism adopted was that of Blom and Morén (2011), which describes generative mechanisms as " ... a trans-empirical but real existing entity, explaining why observable events occur". This view allowed to consider generative mechanisms in the context of this study as the underlying causal structures that explain the observed relationship between IT-use and organisational performance in the context of resource constrained EMS organisations. Therefore, as far as the research question is concerned, organisational performance was linked to two categories of generative mechanisms. These were structural and coordination mechanisms. In particular, the structural mechanisms were (1) IT-infrastructure services and (2) Performance-oriented organisational culture. The coordination mechanisms were: (1) Efficiency of internal business processes, (2) IT-enabled resource optimisation, (3) Real-time performance analytics and (4) Organisational learning.

Hernes (1998) argues that mechanisms are about "the wheel work or agency by which an effect is produced. In this way, mechanisms do not merely address what happened but also how it happened" (p. 74). Hence, in this study the

mechanisms were necessary but not sufficient, given that — using retroduction — mechanisms only specify what could be producing performance outcomes. In contrast to extant literature on IT-use and organisational performance mechanisms, this study highlights the emergent nature of IT-enabled organisational performance, resulting in a more multi-faceted explanation of the generative mechanisms. Contrary to traditional deterministic correlation and regression models of organisational performance, in the real world EMS organisations are not static entities but dynamic and complex, in one way or another. Therefore, the mechanisms of IT-enabled organisational performance cannot be restricted to the empirical level. As was illustrated in the research model in Figure 8.9 in Chapter 8, the mechanisms essentially work through the activation and interactions with other mechanisms that interdependently generated the observed performance outcome. Each mechanism had explicitly defined properties and contextual conditions in which they were triggered as well as way of working.

Specifically, with respect to the second sub-question, the analysis of the environment showed that there are several of factors that influence the role played by IT in the attainment of organisational performance objectives. The case study showed that even though IT-use enabled the attainment of performance outcomes, this was influenced by a number of contextual conditions. These conditions are: (1) Poor performance outcomes with low resources availability; (2) Poor performance outcomes with high resource availability; (3) High performance outcomes with low resources availability and (4) High performance outcomes with high resource availability. These contextual conditions were discussed in detail in chapter 8.

9.3 Revisiting the research objectives

There are four primary objectives, which so far this study has tried to achieve. These are the following:

1. To determine the underlying structures and mechanisms associated with IT-enabled organisational performance in the context of resource-constrained EMS organisations.

2. To explain how the identified mechanisms work.

3. To identify and explain the necessary contextual conditions that allow the identified mechanisms to be activated.

4. To develop a model that links objectives 1, 2 and 3 to derive a CR based explanatory model of performance in resource constrained EMS organisations.

Table 9.1 presents a summary of research objectives, as well as where and how they were addressed in the thesis.

Objective	**Where Addressed**	**How Addressed**
Objective 1	Chapters 7 & 8	The first objective of this study was achieved in Chapters 7 and 8 through the analysis of the case study. Multiple data were obtained from the case and was analysed to determine the mechanisms and structures.
Objective 2	Chapter 8	The second objective was validated in Chapter 8, which discussed how the mechanisms identified worked and their interactions to produce observed performance outcomes in resource constrained EMS organisations.
Objective 3	Chapters 6 and 8	Chapter 6, provided a comprehensive description of context. This helped to provide a basis for identifying and explaining the contextual conditions in Chapter 8. As such, this objective was addressed in Chapter 8, where four contextual conditions identified and discussed.
Objective 4	Chapter 8	After identifying the structures and mechanisms through the inference of abduction and retroduction, a model to link the mechanisms and structures was developed. The research model was based on the critical realist philosophical perspective and illustrated how the mechanisms and structures interacted.

TABLE 9.1: Summary of Research Objectives: where and how they were addressed

9.4 Integration into existing knowledge and contribution to theory

Research on mechanisms that influence organisational performance outcomes in resource-constrained healthcare organisations is scarce in IS literature. This is due to studies predominantly approaching organisational performance phenomena from both positivistic and interpretivist approaches. These approaches have been limited to the empirical level. However, the critical realist approach applied in this study goes beyond the limitations of positivist and interpretivist approaches. As discussed in chapter 3, the critical realist approach has a stratified ontology consisting of three domains of reality: (1) empirical; (2) actual; and (3) real. This ontological stratification goes beyond the empirical domain to include the actual and real domains of realities. The CR ontology, therefore, allows for understanding and explaining the underlying generative mechanisms that give rise to observed outcomes in the empirical domain of reality. With this in mind, it makes sense to review how the findings produced in this study integrate into the existing body of knowledge.

The findings on the generative mechanisms of IT-enabled organisational performance in resource constrained EMS organisations contribute to research on technology use and performance in healthcare organisations (Devaraj & Kohli, 2003; Melville et al., 2004a; Singh & Sittig, 2016). From a CR perspective, the underlying structures and causal mechanism that give rise to the observed performance outcomes which are only experienced on the empirical level are not explained by extant literature. Hence, this study aimed to develop explanations of these generative mechanisms and more importantly, how these structures and mechanisms interacted to bring about the observed performance outcomes.

More specifically, answering calls to explore alternative theoretical perspectives on technology use, as well as the need for greater discourse between limitations of existing research (Astbury & Leeuw, 2010; Avgerou, 2013), in order to increase existing knowledge and towards better understandings of the mechanisms that generate performance outcomes (Wood et al., 1990; S. P.-J. Wu et al., 2015), this study took a CR approach and built on CAS theory as well as institutional theory by linking properties of both theories to explain the mechanisms that generate performance outcomes.

Furthermore, this study extends existing knowledge regarding the role and influence of IT-use on organisational performance, which has previously only been considered from the domain of the empirical. Furthermore, in line with the need for further research on the role IT plays on performance in healthcare organisations (Kohli & Devaraj, 2003; Sabherwal & Jeyaraj, 2015), this study also contributes to organisational performance literature by highlighting how and when mechanisms in the domain of the actual and the real play important roles in order to give rise to the observed performance outcomes. These mechanisms are instrumental to improved organisational performance in resource constrained contexts. Moreover, the developed model in this study enabled a simplified understanding of contextual factors as well as, how the mechanisms generate desired organisational performance outcomes under the identified contextual conditions.

9.5 Theoretical implications of the research

With respect to IT-enabled organisational performance, this study contributes to both organisational and IT in healthcare literature by developing a multi-level research framework informed by the realist philosophical stance. The framework integrates two complementary theories in order to elucidate explanations of the generative mechanisms that give rise to IT-enabled performance outcomes. These theoretical explanations take into consideration three important elements: (1) the technological, cultural and structural mechanisms that influence IT-enabled organisational performance, (2) the unpredictable, non-linear, adaptive nature of EMS environments, and (3) the complexities that arise from the interactions between EMS organisations and their environments.

The proposed research model is intended to serve as a basis for guiding research in the area of IT-enabled organisational performance in resource-constrained EMS organisations. Knowledge about mechanisms can be relevant for policy makers and decision makers such as EMS managers, and supervisors. Although these decision-makers may not be directly involved at the scenes of emergencies, it is important for them to understand how and why IT-use-enabled emergency service work practices are crucial in resource-constrained contexts. This is important because policy makers and decision-makers devise the KPIs and KPAs

that EMS organisations must comply with, as well as setting structures that govern all EMS practitioners as well as all EMS organisations modes of operations. Without understanding the mechanisms that give rise to IT-enabled organisational performance, decision makers risk basing their decisions on poor, unrealistic, or erroneous motives. For example, a decision-maker may decide to adopt and implement a costly IT infrastructure configuration in an under-resourced EMS organisation in a developing country because analysis indicated that IT infrastructure configuration had worked well and helped in achieving good performance outcomes in the Western Cape Province of South Africa. However, if performance outcomes do not depend on the IT infrastructure configuration (mechanism) but, for example, on the organisational culture (mechanism) or the efficiency of business processes, or organisational learning in that EMS organisation (the unobservable mechanism), the decisions to implement the IT infrastructure configuration were made for the wrong reasons. These decisions might have severe long-term consequences on other things such as costs and productivity. Another possible reason for the failure of an IT infrastructure configuration might be because of the different contextual conditions in that developing country may be different from those found in the Western Cape of South Africa. Meanwhile, a cheaper IT infrastructure configuration might work as well because it was designed with consideration of the other mechanisms, such as efficiency of existing business processes and contextual contingencies in the local country.

It is clear that knowledge about generative mechanisms can be useful in specific contexts, in different ways for diverse people (decision and policy makers) and resource-constrained EMS organisations. That is because knowledge of the generative mechanisms provides answers to questions about how and why IT-enabled organisational performance mechanisms work or do not work depending on the context.

9.6 Practical implications

Findings from this study could be integrated into broader emergency medical policy planning and health programmes management. The model developed by the study could assist emergency medical institutions (and practitioners) in South Africa and other sub-Saharan African countries, especially Southern African Development Community (SADC) countries, with a fresh and better understanding of the underpinning mechanisms enabling performance in resource constrained EMS organisations. Knowledge about these mechanisms could help improve EMS delivery to the public especially in poor and underserved communities. In addition, the findings could help to guide better management of emergency medical situations and resources in their respective resource-constrained contexts. Furthermore, findings from the study could also guide better design and implementation strategies of EMS systems initiatives in South Africa and sub-Saharan developing countries. Specifically, the elements of the model consist of two types of generative mechanisms — *structural* mechanisms and *coordination* mechanisms. Together, these (generative) mechanisms give rise to desired organisational performance outcomes which are appropriately balanced by a number of contextual factors. The model has two goals — descriptive and explanatory.

9.6.1 Descriptive

Firstly, the research model developed in this study can be considered a framework that allows organisational scholars and practitioners to identify, organise and describe the necessary set of generative mechanisms that could potentially influence the nature of IT usage in support of EMS delivery in environments characterised by minimal resources. Hence, fundamentally, the research model identifies and describes a set of structural and coordination mechanisms as well as contextual factors that can be used as starting points for conducting investigations in similar contexts. To produce desired organisational performance outcomes, a better understanding of the necessary functional and dysfunctional mechanisms should be established. This can help devise strategies that prevent dysfunctional mechanisms from suppressing the desired performance outcomes.

9.6.2 Explanatory

The second role of the developed model relates to its inherent ability to offer explanatory insights into the necessary mechanisms that give rise to organisational performance. This framework has potential to guide empirical research and provide theoretical explanations into different domains or disciplines that are concerned with identifying organisational mechanisms which influence performance. These include for example, the significance of the several coordination and structural mechanisms which under different conditions of uncertainty produce variations in performance outcomes. Possible alterations to the model can be applied in examining the necessary mechanisms as well contextual factors which may help other EMS organisations adapt the model to their own contexts. The identification of contextual factors and other generative mechanisms may require further research, using the model developed in this study as a foundation.

9.7 Limitations of the research

Limitations refer to the likely weaknesses of the study that were impossible to avoid but were as much as possible minimised. These include for example limitations of the research design, methods and analysis. As such, much like all critical realist studies, this study had limitations of its own. The first limitation concerns the final research model. According to Elster (2015), mechanisms consist of the "nitty-gritty of middle range theory". However, Bygstad (2011) argues that there should be a fine balance between "too generic and too contingent mechanisms". In other words, a mechanism should not be too generic at the risk of losing its explanatory power, and a mechanism should not be too specific for it to only be applicable in a given context. Finding the balance between the two was always challenging in this study as there is no prescribed method to achieve this balance in literature. Therefore, a clear emphasis was placed on evaluating and finding the best combinations of mechanisms as well as contextual conditions in which performance levels can be improved to prevent allocation of resources to inefficient and ineffective business processes that yield poor performance outcomes. Other researchers could have more valid explanations as the framework is inherently emergent and imperfect.

In addition, the researcher could not validate the usefulness of the model back in the empirical situation. Sayer (1992), notes that the identified mechanisms should be considered as candidate explanations, and there should be continuous iterative cycles of data collection and analysis until "closure" is attained. Achieving the process of "closure" is also challenging because there is no prescribed method of achieving closure. As such, no closure was attained in this study.

The second limitation concerns the theoretical choices that were made in the study. This study was based on a combination of two theories: CAS theory and institutional theory. With respect to CAS theory, there are many different conceptualisations, approaches and applications of CAS theory in IS literature. The approach that was chosen in this study is based on Nan (2011) conceptualisation of CAS theory and IT-use. While Nan's (2011) conceptualisation of CAS theory adopted in this study acknowledges the important role of interactions between agents and their environment with respect to IT-use processes. This theory remains relatively limited with regarding to the role as well as influence of material resources on organisational performance, particularly in the context of resource constrained EMS organisations. More importantly, CAS theory remains unclear regarding the role resource management plays at each stage of the interaction process as well as how the social and material resources interact with one another. As such, there are other approaches/conceptualisations of CAS theory that could be used; however, Nan (2011) approach was more relevant given that it focused more on IT use and because the concepts were more relevant to this study. Other conceptualisations of CAS in combination with institutional theory may yield different outcomes and provide different insights into the mechanisms of IT-enabled organisational performance.

The third limitation concerns the design and methods. During the interviewing of subjects, certain categories of stakeholders were not interviewed because of the nature of the work. For example it was difficult to get ambulance paramedics to be interviewed because they are constantly on the road and impossible to join them in the ambulances while on duty. The only time that was possible to interview paramedics was during their lunch times and or after work. It was difficult to find paramedics that were interested in getting interviewed during their precious lunch times.

Finally, with respect to limitations concerning the analysis, Bygstad et al. (2016) model was used to guide the analysis of the mechanisms. However, Bygstad's approach is not the only critical realist data analysis model in IS literature. Indeed, there are other models and frameworks for critical realist data analysis. Example include amongst others Wynn and Williams (2012), Easton (2010), Crinson (2007), Fletcher (2017). The Bygstad model was chosen because of its clarity and systematicity. Moreover, the case study approach was chosen in this study may have generated findings that are mostly relevant to particular contexts — those of resource-constrained public EMS organisations in developing countries. For other types of EMS organisations, for example, private EMS organisations, or EMS organisations in developed countries, or where resource constraints are not an issue, different types of mechanisms than those identified in this study may play a more prominent role in giving rise to observed performance outcomes. Finally, Zachariadis, Scott, and Barrett (2013) recommend going further and pointing to programs of change. This was not done because mechanisms are highly contextual and may be different depending on the context.

9.8 Recommendations for future research

This study has attempted to elucidate the nature of IT-enabled organisational performance mechanisms and in so doing offering a realistic explanatory basis for research focused on IT-use and organizational performance. While the findings may not necessarily constitute the only possible approach to mechanism-based explanation, it is hoped that the findings can stimulate further research in the domain of organisational performance and IT-use in the information systems discipline. Moreover, it is acknowledged that indeed, the nature of critical realist based explanations is possibly one of those subjects to which no terminal explanations will ever exist, therefore, it is concluded that the explanations by mechanisms may provide a key explanatory rationale for developing adequate research designs in information systems studies that use critical realism as a guiding philosophy.

Future research studies may seek to identify and explain additional generative mechanisms influencing organisational performance and the contextual factors that activate such mechanisms as well as the contextual conditions in which they

exist. Further explanations can be produced by exploring how these mechanisms interact with other context such as those of public-private partnerships of emergency services delivery. For example, factors such as information sharing between public and private EMS organisations, and the alignment of organisational goals between both public and private EMS organisations, shared decision making processes, etc. and how these may contribute to explanations of mechanisms of organisational performance in other contexts.

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Appendix A

Information sheet and Consent form

The University of Cape Town requires researchers to apply for ethical clearance before venturing for data collection. The participants involved in the research were given comprehensive details about the research and were given the freedom to withdraw from the research if ever they felt uncomfortable about the questions asked. Finally, the data collected did not in any way entail sensitive participants information such as personal email addresses or personal phone numbers.

Managers were able to provide information on their consent and this information was kept confidential and was only used for the purpose of this research. Below is the information sheet and consent form that were given to managers explaining to them what the research was about.

Information sheet

Department of Information Systems
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Private Bag X3 - Rondebosch - 7701
Tel: +27 (0) 21 650 2261 Fax: +27 (0) 21650 2280
Internet: http://www.commerce.uct.ac.za/informationsystems/

01 December 2015

Dear <Participant Name>

My name is Yasser Buchana and I am a PhD student in the Department of Information Systems at the University of Cape Town.

I would like to invite you to participate in an academic research case study on ***"Generative mechanisms of IT enabled organisational performance in Resource constrained EMS organisations in South Africa"***. I have sought your responses and views because you are a key member of the WCEMS.

I am researching on properties of what is called "complexity theory" or the behaviour of what are called "complex adaptive systems" to determine the value added by inter-organisational information systems to the delivery of emergency medical services and in particular organisational performance. I wish to inform you that this research has been approved by the University of Cape Town (UCT)'s Commerce Faculty Ethics in Research Committee as well as the Western Cape Health Ethics committee.

Confidentiality

Your participation in this research is voluntary. All information will be treated in an anonymous manner and will be used exclusively for the purpose of this study. No individual names will be recorded or published. You will not be requested to supply any identifiable information, ensuring anonymity of your responses. You can choose to withdraw from the research at any time for whatever reason, in accordance with ethical research requirements.

I would like to state up front that I am not critical of any current decision-making processes and secondly that I am not questioning any particular decision that has been taken by an individual or committee in the past. In answering the questions please think about your role in various decision-making committees of EMS. Further, try to think about your own personal opinion and your thinking process about the decisions rather than the presentations provided to the committee or the written submissions. You will probably find the questions quite easy to understand but more challenging to answer – what I will be asking might seem self-evident or even assumed – please concentrate your thinking on how to explain these perhaps basic things.

The interview covers six general areas made up of a number of questions. The questions may seem the same or closely related. The one-on-one interviews will take approximately 30 minutes to 1 hr at the WCEMS premises at Tygerberg. If you are willing to participate in this study, kindly sign the attached form and return to me at your earliest convenience.

Should you have any questions regarding this research, please feel free to contact me on my mobile number 083 7276654 or email: ybuchana@gmail.com.

Thank you for your time and participation.

Sincerely,

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Consent form

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Research Participant Consent Form

I, _____, consent to participate in the research on ***"Generative mechanisms of IT enabled organisational performance in Resource constrained EMS organisations in South Africa"***

I am aware that participation is voluntary and that I may choose to withdraw from this study at any time, should I choose to do so.

_____ _____

Signature Date

Appendix B

Interview guide

Interviews were the primary instrument for data collection. The interviews were also supported by direct participant observations as well as field notes that were taken during both the observations and interviewing processes. There were two sets of questions guided by two theoretical frameworks. The first was based on the CAS theory and the second was based on institutional theory. The duration of each interview was between 30 to 60 minutes. For this study, the interviews were conducted mainly face-to-face at the WCEMS facility. The interviews were audio-recorded using a digital recorder. The backups were stored on a computer to avoid getting lost.

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INTERVIEW GUIDE

CAS Construct		**IT Use Construct**	**CAS interview questions**
Agent		Human actors	*What level (novice and expert) of IT use processes do you have in terms of using the CAD system for your work?*
		IT features	*What are the main building blocks or basic components of the CAD system that enable the management of resources and performance management?* *How do you use these features to enable resource management and overall delivery of emergency services?*
Agent (Sub concept)	*Attribute*	Individual differences	*What role do your demographic backgrounds, cognitive styles, attitudes towards performance and personality traits play in achieving your performance targets?*
		Technology characteristics	*How important is system reliability, flexibility, and richness in delivering emergency services?*
	Behavioural rule	Cognitive activities	*How important is knowledge of the CAD system features in helping you perform your work tasks?*
		IT functionalities	*What functions or capabilities does the CAD system have (e.g information access and performance management) which make it easier to delivery emergency services?*
CAS Construct		**IT Use Construct**	**Interview Questions**
Interaction		User-system interactions	*How do the you adapt to the defined usage rules of the Computer Aided Dispatch (CAD) IT system?* *How do you adapt or modify these usage rules of the CAD system to suit how you want to use the CAD system in order to make it easier to do your work?*
		Interpersonal interactions	*How do you interact/collaborate with your colleagues and how does these interactions help you with work tasks?*
Interaction (Sub concept)	*Connection*	User-system links	*How do the features of the CAD system make it easier for you to do your work?*
		Interpersonal ties	*What working relationships do you have with your colleagues and how does it help you to get your work done?*
	Flow	Movement of intangible IT resources	*How are knowledge, information, and other intangible IT resources shared/distributed among human actors?*

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INTERVIEW GUIDE (*Institutional Theory questions for WCEMS ENVIRONMENT*)

In order to cover the main aspects of the subject of this study, the interview will take approximately 30 - 60 minute and will be guided by the following open ended questions.

Background

Organisation:

Job title:

Years with organisation:

Interview questions

1) How would you describe current WCEMS organisational performance?
2) Who are the main actors/stakeholders that defines performance metrics and set performance targets for WCEMS?
3) Who are the main stakeholders (if any) that play a role in monitoring and evaluating organisational performance?
4) What influences these performance metrics definitions? And why?
5) What are the main institutional factors do you think influence organisational performance in WCEMS?
6) What role does the environment play in delivering emergency services?
7) How would you describe the organisational culture within WCEMS?
8) What role do you think this culture plays in influencing delivery of emergency services?
9) What role do you think information Technology usage play in improving organisational performance?
10) How do you think IT usage has made it easier or difficult for WCEMS to deliver emergency services?
11) How would you describe the socio-organizational contexts in which WCEMS operates?
12) What properties of such socio-organizational contexts (such as business strategies, culture, rules, and work requirements) do you think influence how WCEMS delivers emergency services?

Appendix C — Example of Mechanism analysis

Examples from empirical evidence	Basic category	Organising category	Researcher's memo/Probing questions (Abductive-retroductive questions)	High level theme/ Linked mechanism
"... basically we permanently *monitoring our infrastructure services. We have various stakeholders that are our service* providers, we make sure that all the latest updates are done on time, so that we get the best out our infrastructure services, because *if you don't constantly monitor your infrastructure, then the machines, servers and all other services are going to get sluggish and that's going to affect productivity" --- **ICT Manager#1*** *if you have bad IT systems, and good staff, you also not going to get the best performance outcomes, your situational awareness is limited **-- ICT manager#1*** *The IT infrastructure underlies everything we do here.* Ok, from ICT Point of view. So that's your framework essentially this includes for example, your connectivity infrastructure which would include an NPLS cloud, which includes your you know things like your mobile operators. You know the 3G connectivity, in there is satellite, provided by external providers. ... then there is the mobile infrastructure. Which is essentially what's the	Monitoring of IT infrastructure services.	Monitoring of IT infrastructure services.	What underpins all IT enabled provision of emergency services	IT infrastructure services

fixed infrastructure in a vehicle (ambulance) if you can call it that. It allows use to track things like your Mobile Data Terminals, Patient Data terminals ... And *then there's the applications which include the Computer Aided Dispatch system. which includes rostering and fleet management.* basically those. Those are the main ones. Even though there's a lot of overlap because healthnet will include mobile data terminals one has its own kind of specific workflow --- ***ICT manager***	Importance of having resilient IT infrastructures			

"*In this organisation, or in the government we have the Staff Performance Measuring System (SPMS). It's only done once a year. The chances of getting it is very slim . People have to work hard in order to qualify for bonus.* I am currently working on something. ***--- Quality Assurance analyst#1*** *because of the fact the they were better informed or it was communicated to them. Because you can just give feedback to non-performers. You need a good performer that they are performing well. But you know another thing that makes people despondent, you know a lot of these guys come from the private sector, i also come from the private sector, we had a reward and recognition, . So you can reward people for good performance.* ***--- Supervisor#4*** *" ... the SPMS, still plays a big role. So if you do not meet your KPIs you will not get your 13th cheque." ---**Manager#3***	Reward system to motivate staff to meet performance targets Internal culture motivated by incentives	Prevalent Culture of rewarding good performance	What allows for WCEMS employees to have a uniform outlook on organisational performance?	Performance oriented culture

I have assessed a few calls and have identified the excellent performers and the not so good performers, and the really bad performers. I can identify who they are already." ***Quality Assurance analyst#1*** *The new IT system has also brought in change with the operations staff as well as the communication staff, because now they know they are being watched, they've being measured on performance, attitudes and their willingness to adapt and that's been a real change for the health and wellness team of EMS* ***– Training manager#1***	Internal pressure to meet performance targets		What is it that drives this organisational wide focus on performance ?	
technology should be an enabler not a Substitute. and. Initially we had difficulty discerning for when it's enabling and when you're substituting. And often it's was people's inability to shift to a new process. We saw it with the initial rollout is although the system had far more capabilities and far more functionality than the old one, *the user although trained on how to use it still resorted on a set of business processes that were more suited to the old solution than the new solution.* So even though people you know could do so much more with it they then they just defaulted to old ways. So when we look at it and say did we	Re-engineering of internal business processes in order to make them efficient	Fixing or re-engineering business processes for efficiency		Efficiency of internal business processes

re-engineer our processes pure. --- ***Manager#4*** if we see improvement in performance then, we will confidently say that we have we have gained efficiencies we are getting consistency. Getting the right decisions happening more frequently to the best possible performance measure and then say Well I think the processes are tune. --- ***Center manager*** *The processes need to be fixed first and the IT system is only an enabler to get there, it's not the salvation. It's not the messiah we looking for. In fact, it will only just expose how poor our processes are* --- ***ICT manager #1*** If we understand the way processes affect performance then it means we would understand how people affect the processes and then our understanding of the way the technology can be harnessed can be better ***--- Manager #5***	Importance of having efficient business processes		What is it that allows for efficient and effective delivery of emergency services?	

"... We *reshuffle and try to equalise the shift.* Based on the amount of people we have according to the language Afrikaans and Xhosa. Use overtime, change hours according to the peaks. Say we get 200 calls that come into the center from 12 to half past 6 in the evening, so we won't use 12 hour shifts" --- **Supervisor#1** "...From *only eleven ambulances allocated to each dispatcher, you have to find ways to manage them accordingly. So when demand for emergency cases is very high, we use the CAD system to interrogate which resources are not engaged or used optimally.* So, you have to reshuffle the resources around to accommodate everyone." **--- *Dispatcher#3*** I sometimes think you know some improvement of performance is not always working hard to achieve it. it's kind of working smarter you, know getting in tune with the different variables and then working with them in *order to achieve performance. because you know if you go certain percentage of the crew doing 11 calls on a shift and others are only doing 4, if everybody did 7 for example, you'd achieve the same kind of performance*, but with less work. and once everybody's doing 7, then let's see if we can squeeze another two or three on each paramedic --- ***supervisor 5***	Resource reshuffling to meet demands of emergency services	Optimal use of resources	What must exist to equalise and make better use of the limited resources?	IT-enabled resource optimisation

... Because of *real time reports, there are more interactions between staff and supervisors, especially in the districts managers, because now everybody is on par.* Everybody gets the same reports at the same time in real time. So every body is on par as what is happening out there. Whereas, previously, they were disconnected from the staff on the road ..." ***--- Manager 5*** "We were constantly looking at it every seven days. It started every three months, every month. And we said, let's look at it every week. but irrelevant because we weren't looking at it in a way that would able us to change our behaviour. *So when we started looking at nearer time reports; 15 minutes, half an hour, an hour. it Changed we were then able to make decisions based on that real time reports.* --- **Center manager** But in order to achieve performance we need a team of one thousand six hundred. What the real time repots now enables us to do is to move from that 160 to 1600 hundred people and once we can share real-time reports with 1600 hundred people, the performance would improve. The system is designed to be able to do that. Decisions designed to be able to measure performance in real time and share that --- manager 4	Having real time reporting and analytics allows for better situational awareness	Real time analytics	What is it that must exist in order to enable managers to make quick and instantaneous decisions based on reports?	Real Time performance analytics

"... *We have over the years realised that Mondays tend to be abit busier, and it peaks from 14:00 onwards, with the amount of incoming calls,* because the clinics close at 16:00. So, the facilities (clinics) would start calling in requesting for ambulances to transport patients. So, *when that happens and when we do not to have enough human resources for call taking, then everybody jumps in to help where they can, especially when he queue of calls waiting is too long, or when we get twice the amount of calls."* --- **Supervisor#2** "...If you take for example, Eden and Karoo. Now to run the Karoo center, you need atleast 10 staff plus one manager. For Eden, because it's busier, you require at least 20 staff plus 1 supervisor and 1 manager. *The problem is that their call volume is very low.* They might only do about 10 calls a night, *so let's say might do 30 calls in a day but you still have to staff it for those calls. And because it's unpredictable how those calls would come in, you have to prepare for the worst."*--- **Manager#2**	Learning from previous experiences	Organisational learning	What is it that allows to constantly improve on performance from previous experiences?	Organisational learning